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BULLETIN

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SOCIÉTÉ ENTOMOLOGIQUE D'EGYPTE

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FONDÉE LE 1er AOUT 1907

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THE APHIDIDAE OF EGYPT

[*Hemiptera-Homoptera*]

(with 72 Text-Figures)

by Drs. A. HABIB and E. A. EL-KADY,

Plant Protection Department,
Faculty of Agriculture, Ain Shams University.

INTRODUCTION

WILLCOCKS (1922), in his "Survey of the economic insects and mites of Egypt", has recorded a great number of aphids and paid special attention to the colour of living specimens, collected since 1907, and to their host plants. THEOBALD published four papers in 1913, 1915, 1918 and 1920 on African Aphididae. He gave morphological descriptions and drew few illustrations for material collected from Egypt and other regions from Africa. In 1922, he published a paper dealing only with Egyptian Aphididae collected by WILLCOCKS. Previous knowledge on the Aphididae of Egypt was summarised by HALL (1926) in a paper in which 78 species were listed. Recently SOLIMAN (1937) added two new species which he related to two new genera. The most important studies which were carried out since that date are those of SOLIMAN (1951), who studied the morphological features of different stages of *Myzus persicae* Sulz.; HASSAN (1957), who carried out some studies on the morphology and biology of *Rhopalosiphum maidis* (Fitch); and KOLKAILA (1953) who studied the morphology of *Pentalonia nigronervosa* Coq. and its relation to the Bunchy top disease of banana.

The taxonomic studies of aphids have been nearly completely neglected since the valuable. work of HALL (1926), in spite of the revolutionary changes in the nomenclature dealing with. The identification of aphid material, in Egypt, is mainly based on the colour of the living specimens, their host plants and scarcely on comparing mounted specimens .with the authentic material ˙when available.
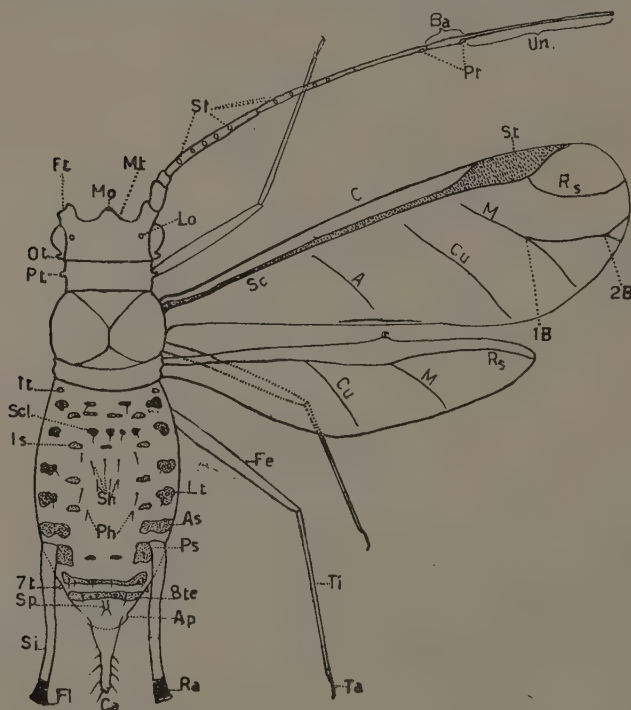

FIG. 1: A hypothetical figure for an aphid. — *Head:* Ba, basal part of 6th antennal segment; Ft, frontal tubercle; Lo, lateral ocellus; Mo, median ocellus; Mt, median tubercle; Ot, ocular tubercle; Pr, primary rhinaria; Sr, secondary rhinaria; Un, unguis. — *Thorax:* Fe, femur; Pt, prothoracic tubercle; St, stigma; Ta, tarsus; Ti, tibia; 1 and 2B, 1st and 2nd branches. — *Abdomen:* As and Ps, ante- and post-siphuncular sclerites; Ap, anal plate; Ca, cauda; Fl, flange; Is, intersegmenlal sclerites; Lt, lateral sclerite within a lateral tubercle; Ph, pleural hairs; Ra, reticulated apex; Scl, scleroites; Sh, spinal hairs; Si, siphunculus; Sp, supra caudal process; 1t and 7t, 1st and 7th agdominal tubercles; 8te, 8th tergite.

For the wide variations of host plants of the same species, the colour of aphids is always affected by environmental factors, and in

together with the lack of authentic material were the motives for carrying out this taxonomic part of the work.

With regard to the classification of the higher groups (keys to Sub-Families, to Tribes and Sub-Tribes), the system adopted is that of EASTOP (1958) which is based on that developed by MORDWILKO, BOERNER and HILLE RIS LAMBERS. The writers, however, have constructed keys for identifying the Egyptian genera and related species. These keys are mainly based on the description of the alate viviparous females, since these forms were usually collected from the field and since they usually presented a better combination of characters for recognition than other forms. It was also easy to rear alate forms in the laboratory by confining the apterous forms to a part of the host plant in a Petri dish.

The keys given hereafter are not deviced to show phylogenetic relationships, even though they may sometimes fulfill this view ; but they are intended primarily to simplify the identification as much as possible.

The specimens used in this study were mainly collected by the writers, either from their host plants or caught in light traps. The collection of the Aphid Department of the Ministry of Agriculture was carefully examined together with HALL's authentic material kept in the Ministry. Specimens were sometimes borrowed from the British Museum for comparative purposes.

Owing to the lack of the illustrations of many of the Egyptian species and to the inadequate drawings of some others, it was found more convenient to give new illustrations for all the species except few ones of which spcimens were inavailable. Redescriptions and additional notes for colour, general shape, relative lengths of the various parts of the body and structural characters ars also given for only alate viviparous females of each species and for only four alate males.

SUMMARY

A key to the Egyptian Aphididae (80 species) was constructed by the writers with biometric data and drawings for most of the species. This taxonomical study revealed a revolutionary change in the nomenclature of the Egyptian Aphididae (78 species) given by HALL (1926) and additional records which were made by the present writers as shown in the list given here after. This study can be summarised as follows ·

(1) Six species are now considered as synonyms to species in the list of HALL (1926).

(2) Twenty-two species are now considered as synonyme to other species not included in HALL's list.

(3) Eleven species are transferred to other genera.

(4) The three species of *Cavariella capreae* F., *Aphis pomi* De Geer and *A. laburni* Kalt. are not actually present in Egypt.

(5) SOLIMAN (1937) recorded the presence of two new genera, one of which (*Masraphis* Sol.) is a synonym to another genus (*Melanophis* V. d. Goot).

(6) Six species namely *Tetraneura hirsuta* Baker, *Capitophorus hippophaes* (Walker), *Chomaphis (Dysaphis) tulipae* (B.d.F.), *Ceurnavaca noxius* (Mordw.), *Rhopalosiphum padi* (L.) and *Hysteroneura (Schizaphis) minuta* (V. d. Goot), were newly recorded by the writer in Egypt.

(7) *Macrosiphoniella parthinii* is a new species, described by the writers.

(8) Alate males of the following three species : *Myzus persicae* (Sulzer), *Brevicoryne brassicae* (L.) and *Rhopalosiphum maidis* (Fitch), were newly recorded in Egypt.

LIST OF THE EGYPTIAN APHIDIDAE

Family Aphididae

I.   SUB-FAMILY CALLIPTERINAE

Tribe Saltusaphidini : *Saltusaphis scirpus* Theo.

Tribe Chaitophorini : *Chaitophorus inconspicuus* Theo., *Chaitophorus populi* (L.).

Tribe Callipterini : *Therioaphis trifolii* (Monell) (previously *Callipterus ononidis* (Kalt.).

II.   SUB-FAMILY THELAXINAE

Anoecia corni (Fab.).

III.   SUB-FAMILY ERIOSOMATINAE

Tribe Eriosomatini : *Eriosoma lanigera* (Hausm.), *Tetraneura hirsuta* Baker, *Tetraneura cynodontis* Theo., *Tetraneura aegyptiaca* Theo.

Tribe Fordini : *Geoica spatulata* Theo., *Geoica phaseoli* (Pass.).

Tribe Baizongiini : *Aploneura lentisci* (Pass.) (previously *Rhizobius graminis* Buck.), *Asiphonella dactylonii* Theo.

Tribe Pemphigini : *Phleomyzus passerinii* Sign., *Pemphigus globulosus* Theo.

IV. SUB-FAMILY LACHNINAE

Tribe Cinarini (Sub-Tribe Cinarina) : *Cinara thujafilina* (Del Guercio) (previously *Dilachnus thujafolia* Theo.).

Tribe Eulachnini (Sub-Tribe Eulachnina) : *Eulachnus tuberclostemmata* (Theo.).

Tribe Lachnini (Sub-Tribe Lachnina) : *Tuberolachnus saligna* (Sulzer) (previously *Pterochlorus viminalis* (B.d.F.)), *Pterochloroides persicae* Chol.) (previously *Pterochlorus persicae* (Chol.)).

V. SUB-FAMILY APHIDINAE

Tribe Macrosiphini : *Cavariella aegopodii* (Scop.), *Cavariella capreae* F., *Pentalonia nigronervosa* Coq., *Idiopterus nephrolepidis* Davis, *Eucarazzia elegans* (Ferrari) (previously *Rhopalosiphoninus salvae* Hall), *Dactynotus sonchi* (L.) (previously *Macrosiphum sonchi* (L.)), *Dactynotus (Uromelan) solidaginis* (Fab.) (previously *Macrosiphum solidaginis* (Fab.)), *Dactynotus (Uromelan) jacae* (L.) (previously *Macrosiphum jaceae* (L.)), *Macrosiphum rosae* (L.), *Macrosiphum (Sitobion) avenae* (Fab.) (previously *Macrosiphum granarium* (Kirby)), *Macrosiphoniella sanborni* (Gill.), *Macrosiphoniella parthinii* n. sp., *Macrosiphoniella abthinthii* (L.), *Macrosiphoniella artemisiae* (B.d.F.), *Myzus persicae* (Sulzer) together with the male, *Myzus plantagineus* Pass., *Myzus amygdalinus* Fars., *Rhodobium porosum* (Sand.) (previously *Macrosiphum rosaefolium* Theo.), *Chaetosiphon (Pentatrichopus) tetrahodus* (Walk.) (previously *Capitophorus tetrahodus* (Walk.) = *neorosarum* Theo.), *Capitophorus hippoppaes* (Walk.), *Capitophorus elaeagni* (Del Guercio) (previously *Capitophorus bragii* (V. d. Goot)), *Pleotrichophorus chrysanthemi* (Theo.) (previously *Capitophorus chrysanthemi* Theo.), *Coloradoa rufomaculata* (Wilson) (previously *Rhopalosiphum lahorensis* (Das.)), *Acyrthosiphon pisum* (Harris) (previously *Macrosiphum pisi* (Kalt.)), *Hyadaphis coriandri* (Das.) (previously *Hyalopterus obscurus* Theo.), *Hyadaphis apii* Hall, *Brachycaudus amygdalinus* (Schout.) (previously *Anuraphis aegyptiaca* Hall), *Brachycaudus helichrysi* (Kalt.) (previously *Anuraphis helichrysi* (Kalt.), *Brevicoryne brassicae* (L.) together with male, *Lipaphis erysimi pseudo-brassicae* (Davis) (previously *Aphis pseudo-brassicae* (Davis)), *Nasonovia (Hyperomyzus) lactucae* (L.) (previously *Rhopalosiphum*

lactucae (L.)), *Chomaphis* (*Dysaphis*) *inculata* (Walk.) (previously *Anuraphis apiifolia* Theo.), *Chomaphis* (*Dysaphis*) *foeniculus* (Theo.) (previously *Anuraphis foeniculus* Theo.), *Chomaphis* (*Dysaphis*) *tulipae* (B.d.F.), *Chomaphis cynarae* (Theo.) (previously *Anuraphis cynarae* (Theo.)).
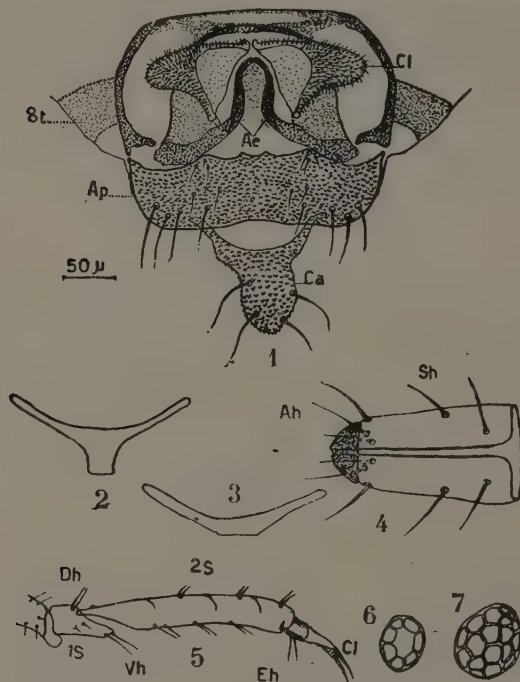

FIG. 2: 1. Male genitalia of *Hyalopterus pruni.*· — As, aedeagus (tucked forward between claspers); Ap, anal plate; Ca, cauda; Cl, claspers; 8t, 8th abdominal tergum. — 2 and 3. Mid-thoracic furca with or without base respectively. — 4. Apical rostral segment: Ah, 6 apical primary hairs; Sh, 4 secondary hairs. — 5. Tarsus: Cl, claws; Eh, empodial hairs; 1s, 1st tarsal segment with 2 dorsal hairs (Dh) and 4 ventral hairs (Vh); 2s, 2nd tarsal segment. — 6 and 7. Wax plates.

Tribe Aphidini (Sub-Tribe Aphidina): *Brachyunguis tamaricis* (Licht.) (previously *Pergandeidia tamaricifoliae* Hall), *Aphis verbasci* Sckrank (previously *Aphis buddliae* Theo.), *Aphis compositae* Theo., *Aphis gossypii* Glover (previously *Aphis ficus* Theo.), *Aphis medicaginis* Koch, *Aphis craccivora* Koch (previously *Aphis leguminosa* Theo. = *Aphis cistiella* Theo.), *Aphis genistae* Scop., *Aphis punicae* Pass.

(previously *Aphis durantae* Theo. = *Aphis punicella* Theo.), *Aphis zizyphi* Theo., *Aphis acetosella* Theo., *Aphis mathiolae* Theo., *Aphis rumicis* L., *Aphis pomi* De Geer, *Aphis laburni* Kalt.

Tribe Aphidini. (Sub-Tribe Rhopalosiphina): *Ceurnavaca noxius* (Mordw.), *Clypeaphis suaedae* Soliman, *Hyalopterus pruni* (Geoffrey) together with male, *Rhopalosiphum rufiabdominalis* (Sassaki) (previously *Aphis splendens* Theo.), *Rhopalosiphum maidis* (Fitch) together with male (previously *Aphis maidis* Fitch = *Aphis africana* Theo.), *Rhopalosiphum nympheae* (L.), *Rhopalosiphum padi* (L.), *Melanaphis phyllotachia* (Soliman) (previously *Masraphis phyllostachia* Soliman), *Longiunguis donacis* (Pass.) (previously *Hyalopterus insignis* Theo.), *Hysteroneura* (*Schizaphis*) *cyperi* (V. d. Goot) (previously *Acaudus calami* Theo. = *Toxoptera acori* Theo.), *Hysteroneura* (*Schizaphis*) *graminum* (Rond.) (previously *Toxoptera graminum* (Rond.), *Hysteroneura* (*Schizaphis*) *minuta* (V. d. Goot).

KEY TO THE SUB-FAMILIES

1(2) Cauda knobbed and anal plate bilobed or idented. First tarsal segments often with a pair of dorsal hairs. Dorsal hairs on the second tarsal segments normal. Empodial hairs often flattened. Siphunculi present, but short or ring-like, rarely longer than their basal width. Usually feeding on the aerial parts of trees and shrubs, rarely on herbs ... ... *Callipterinae*

— Cauda elongate, triangular or broadly rounded, very rarely knobbed. First tarsal segments without dorsal hairs. Empodial hairs hair-like 2

2(1) M of fore wing once-branched or simple. Antennae sometimes only 5-segmented or less. Unguis short, usually less than half as long as the basal part ; secondary rhinaria often annular, sometimes elongate-oval or circular. Siphunculi either on small cones, or reduced to mere rings or absent, never elongate. Cauda rounded or rarely knobbed, never elongate. Wax plates present or absent 3

— M of fore wing usually twice-branched, sometimes once-branched. Antennae usually 6-segmented sometimes 5-segmented ; secondary rhinaria circular or oval, never annular. Siphunculi elongate, short or placed on hairy cones. Cauda elongate or broadly rounded. Wax plates absent 4

3(2) Siphunculi present. Cauda knobbed or rounded. M. of fore wing
     usually once-branched. Free-living insects on the leaves and
     stems, rarely on grass roots, in which case conspicuous lateral
     abdominal tubercles present   ... ... *Thelaxinae**
  — Siphunculi present or absent. Cauda rounded. M of the fore wing
     once-branched or simple. Usually on roots, rarely in woolly
     masses on the aerial parts ... ... *Eriosomatinae**
4(2) Siphunculi on hairy cones. Cauda broadly rounded. Unguis short
     and thick, less than ½ the basal part. First tarsal segments usually
     large, hairy insects feeding on the bark of the twigs, branches or
     trunks of trees (sometimes on Conifer needles or on roots when
     the siphunculi may be reduced to mere rings or even be absent)
     ... ... *Lachninae*
  — Siphunculi usually elongate, if short, not on hairy cones. Cauda
     usually elongate, sometimes rounded. Unguis always slender and
     usually much longer than the basal part. First tarsal segments
     with 2 to 5 hairs ... ... *Aphidinae*

I. Sub-Family CALLIPTERINAE

Characterised by the knobbed or semi-circular cauda and the often
bilobed anal plate. Siphunculi short, about equal in length to their
basal width or reduced to mere rings. The first tarsal segments usually
bear 5 to 7 ventral hairs with two dorsal hairs.

KEY TO THE TRIBES

1(2) Triommatidion present. Head not elongate 2
  — Triommatidion absent.   Head often elongate ... ... *Saltusaphidini*
2(1) Body and antennae armed with rather long, prominent hairs   ...
     ... ... *Chaitophorini*
  — Body and antennae usually with minute, sometimes stout bristles
     only ... ... *Callipterini*

1. Tribe SALTUSAPHIDINI

The only known Egyptian genus is *Saltusaphis* Theo.

─────────
(*)   The two sub-families *Thelaxinae* (represented in Egypt by one species
only namely *Anoecia corni* (Fab.)) and *Eriosomatinae* are not easily distin-
guished according to their alate forms. Apterae, however, could be distinguish-
ed as follows:
3(2) Head and pronotum of apterae fused. 2nd tarsal segments often with
      dorso-apical capitate hairs ...   . *Thelaxinae*
  —   Head and pronotum distinct. Tarsal hairs normal, short and pointed
      ... ... *Eriosomatinae*

Genus SALTUSAPHIS Theobald

(Type : *Saltusaphis scirpus* Theo.)

1915. *Saltusaphis* Theo., *Bull. Ent. Res.*, VI (2), p. 138.

Head elongate with a long space between the frons and the large, prominent eyes. Triommatidium absent. Antennae 6-segmented. Proboscis short, not reaching the second pair of legs. Thorax large. Fore wings with the M twice branched ; hind wings with the Cu usually absent. Legs short, with the fore and mid femora expanded. Siphunculi small and cup-shaped. Cauda knobbed. Anal plate divided. Caudal extremity of the abdomen sometimes bilobed. Body covered with spines which are modified into different shapes.

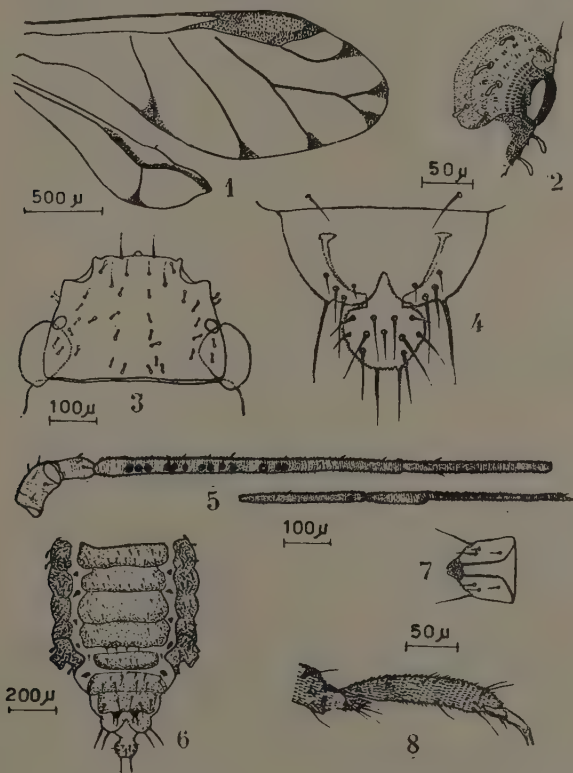Represented in Egypt by one species, namely *S. scirpus*.

FIG. 3: *Saltusaphis scirpus* Theo. — 1. Fore and hind wings; 2. Siphunculus: 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Saltusaphis scirpus Theobald

1915. *Saltusaphis scirpus* Theo., *Bull. Ent. Res.,* VI, p. 138.
1953. *Saltusaphis africana* Eastop, *Ent. Mon. Mag.,* LXXXIX, p. 202.

Found in Egypt by WILLCOCKS in 1910 on sedge (*Scirpus sp.*). Wrongly considered by EASTOP (1953) in Kenya as *S. africana.*

Head with fan shaped hairs characterised by laying antennae on surface of leaf when at rest. Eyes without triommatidion. Antennal formula 3-6-4-5 ; unguis is little longer than twice as long as the basal part ; number of rhinaria on 3rd antennal segment is 16 ranging from 12 to 21. Apical rostral segment with 2 secondary hairs. First tarsal segment of hind leg bears 4 hairs. Fore wing with M twice branched ; hind wings with one oblique vein ; wing veins, boardered with a triangular fuscous area at margin of wing. Each abdominal segment with a dorsal transverse pigmented band ; lateral sclerites present ; a circular pigmentation surrounding the siphunculi. A pair of well-developed tubercles occur on the eighth segment with a pair of long hairs each. Cauda knobbed and anal plate bilobed.

MATERIAL : One specimen caught on the light trap, 28 Dec. 1958, Koubba Palace (authors' coll.) ; four specimens on *Cyperus* sp., 7 Dec. 1944, Dokki (coll. Min. Agric.).

2.   Tribe CHAITOPHORINI

Its members are similar to those of the *Callipterini,* but differ in that their bodies are prominently covered with long hairs.

Represented in Egypt by one genus namely *Chaitophorus* Koch.

Genus CHAITOPHORUS Koch

(Type : *Aphis populi* L.)

1854. *Chaitophorus* Koch, *Die Pflanzenlaeuse Aphiden,* p. 1.
1870. *Transaphis* Walker, *The Zoologist,* p. 1999.
1870. *Arctaphis* Walker, *The Zoologist,* p. 2000.
1912. *Micrella* Essig, *Pom. Coll. Journ. Ent.,* IV, p. 716.
1912. *Eichochaitophorus* Essig, *Pom. Coll. Journ. Ent.,* IV, p. 721.

Antennae 6-segmented, with subcircular rhinaria and rather prominent hairs. Fore wings with the M normally twice branched ; hind wings with both M and Cu present. Siphunculi present, truncate, rather prominent. Cauda distinctly knobbed. Anal plate entire, sometimes idented.

Represented in Egypt by two species namely *Chaitophorus inconspicuus* Theo. and *C. populi* (L.).

Key to the Species

1. Sixth antennal segment longer than the third *inconspicuus* Theo.
— Sixth antennal segment shorter than the third ... ... *populi* L.

Chaitophorus inconspicuus Theobald

1922. *Chaitophorus inconspicuus* Theo., *Bull. Soc. Roy. Ent. Egypte*, VII, p. 39.

Found in Egypt on poplar (*Populus alba*). THEOBALD described the alate females and recorded the presence of apterous males.
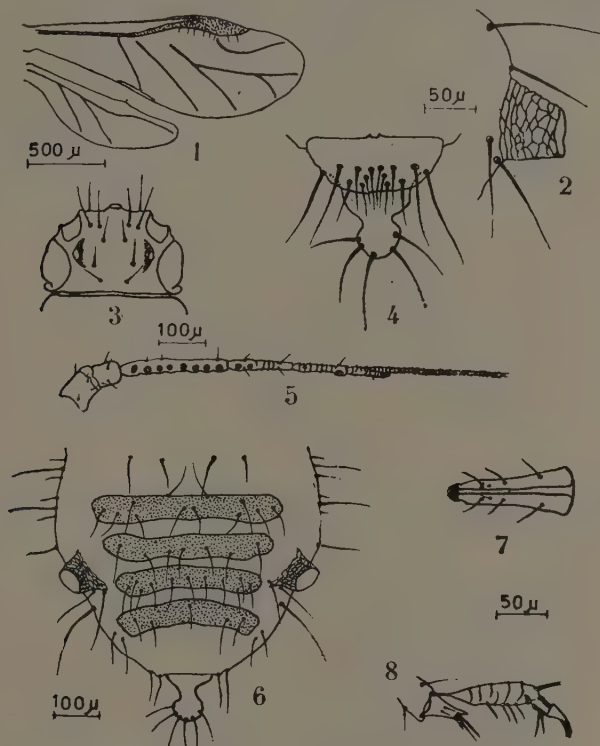

FIG. 4: *Chaitophorus inconspicuus* Theo. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Body entirely covered with long hairs. Antennal formula 6-3-4-5 ; unguis about 2.5 as long as the basal part ; number of rhinaria on 3rd and 4th antennal segments is 11 ranging 8-14 and 1 ranging 0-2 res-

pectively. Apical rostral segment with 2 secondary hairs. First tarsal segment of hind legs bears 5 setae. Wing venation normal; about 8 setae present along R beneath the stigma. Siphunculi short, truncate with about ¾ distal half polygonally reticulated. Cauda distinctly knobbed. Four dorsal transverse sclerotised bars present on the abdomen; lateral sclerites absent; post- and ante-siphuncular sclerites also absent.

MATERIAL: One specimen caught on the light trap, 2 Dec. 1957, Koubba Palace (authors' coll); and 3 specimens on Poplar, 13 Oct. 1924, Giza (coll. Min. Agric.).
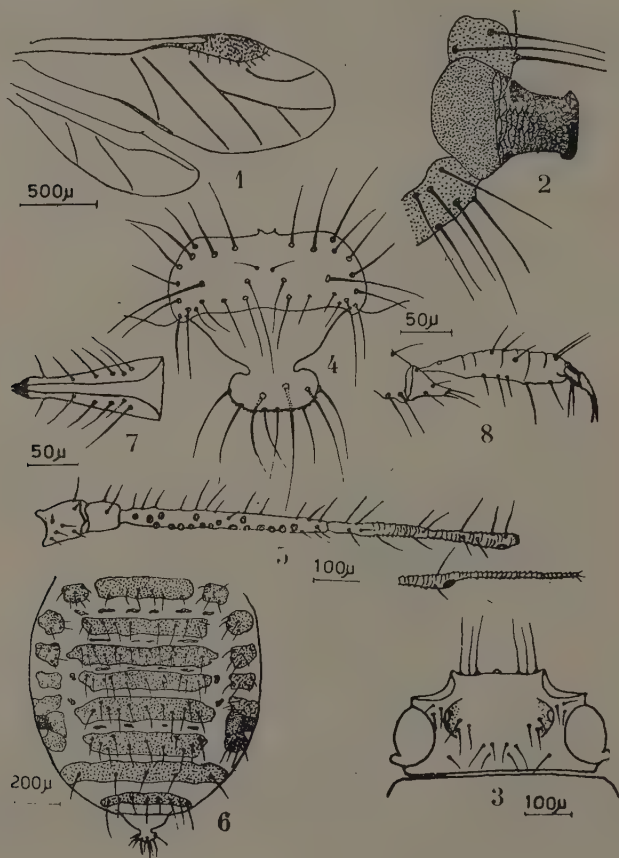

FIG. 5: *Chaitophorus populi* (L.). — 1. Fore and hind wings; 2. Siphunculus; culus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Chaitophorus populi (Linnaeus)

1767. *Aphis populi* L., Syst. Nat., II, p. 736.
1812. *Aphis populeti* Panzer, Faun. Ins. Germ., XXVII, p. 18.
1841. *Aphis populi-albae* Boyer de Fonscolombe, *Ann. Soc. Ent. France*, X, p. 187.
1857. *Chaitophorus versicolor* Koch, Die Pflanz., p. 10.
1857. *Arctaphis populi*, after Theobald (1915), *Bull. Ent. Res.*, VI.
1857. *Chaitophorus leucomelas* Koch, *Bull. Ent. Res.*, VI.
1872. *Chaitophorus leucomelas Lyratus* Ferrari, Spec. Aphid. Liguriae, p. 232.
1915. *Chaitophorus populi* Theobald, *Bull. Ent. Res.*, VI, p. 103.
1926. *Chaitophorus populi* Hall, *Tech. and Scient. Serv.*, Min. Agric. Egypt, Bull. No. 68.

First recorded in Egypt by WILLCOCKS on *Populus alba* and re-described by THEOBALD (1915) and HALL (1926).

Antennal formula 3-6-4-5 ; unguis about 2.3 times as long as the basal part ; number of rhinaria on 3rd and 4th antennal segments is 14 ranging 10-20 and 1 ranging 0-2, respectively. Apical rostral segment with 6 long secondary hairs. First hind tarsal segment with 5 hairs. Wing venation normal ; about 12 setae present along R beneath the stigma. Abdomen with well-developed three marginal sclerites ; post- and ante-siphuncular sclerites present ; 6 transverse bars occur on the abdomen dorsally ; the 7th and 8th tergites present ; intersegmental sclerites also present. Siphunculi short and truncate with almost polygonal reticulations. Cauda distinctly constricted.

MATERIAL : Ten specimens, on *Populus albus*, 12 May 1924, Giza (coll. Min. Agric.).

3. Tribe CALLIPTERINI

Body often armed dorsally with prominent spines or tubercles. Antennae 6-segmented with setae or spines and with subcircular or rarely elongate rhinaria. Wings often clouded, mottled or banded. Siphunculi present, truncate in form. Cauda knobbed. Anal plate usually more or less idented or bilobed.

Represented in Egypt by one genus namely *Therioaphis* Walker.

Genus THERIOAPHIS Walker

(Type : *Aphis ononidis* Kalt.)

1870. *Therioaphis* Walker, *The Zoologist*, p. 1999.
1905. *Kallistaphis* Kirkaldy, *Can. Ent.*, XXXVII, p. 417.
1906. *Eucalipterus* Schouteden, *Ann. Ent. Soc. Belg.*, L, p. 31.
1915. *Neocallipterus* Van der Goot, Beiträge zur Kennt. der Holl. Blattläuse, p. 320.

Antennae 6-segmented without hairs and armed with subcircular or oval rhinaria. Prothorax rather long ; anterior coxae greatly en-

larged. Fore wings with M twice branched; hind wings with both M and Cu present. Dorsal abdominal pattern consisting of at least 4 longitudinal raws of sclerites, each of which bears one or two hairs. Cauda knobbed. Anal plate deeply bilobed.

Represented in Egypt by one species namely *Therioaphis trifolii* (Monell).

Therioaphis trifolii (Monell)

1846. *Aphis ononidis* Kaltenbach, *Ent. Zeit.*, III, p. 173.
1857. *Chaitophorus ononidis* Koch, Die Pflanz., p. 5.
1863. *Myzocallis ononidis* Pass., Aphid. Ital., p. 53.
1882. *Callipterus trifolii* Monell, *Can. Ent.*, p. 14.
1889. *Chaitophorus masculatus* Buckton, *Ind. Mus. Notes*, IV, p. 277, pl. 17, fig. 1.
1915. *Callipterus ononidis* Theobald, *Bull. Ent. Res.*, VI, p. 103.
1915. *Therioaphis trifolii* (Monell), after Eastop, 1958, Colonial Office, Hull Printers Ltd., London.
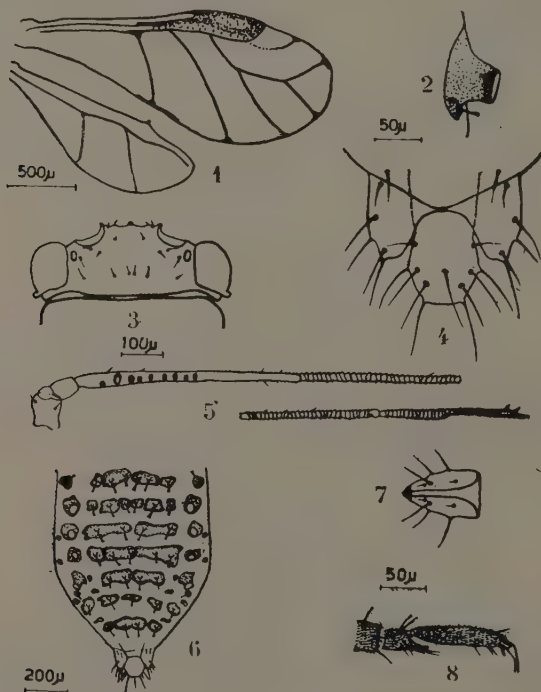

Fig. 6: *Therioaphis trifolii* (Monell). -- 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Commonly known as yellow clover aphis. Misidentified as *Therioaphis ononidis* Kalt., which is a distinct species specific to *Ononis* sp. and known only from Europe (EASTOP, 1958).

First recorded in Egypt by WILLCOCKS (1922) on *Trifolium alexandrinum, T. pratense, Ononis spinosus* and *Medicago sativa*. Redescribed by THEOBALD (1915).

Antennal formula 3-4-5-6 ; unguis nearly equally as long as the base ; number of rhinaria on the 3rd antennal segment is 8 ranging 6-10. Apical rostral segment with 4 secondary hairs. Wing venation normal ; basal third of R_s in the fore wing obscure. First hind tarsal segment bears 7 hairs (2 dorsally and 5 ventrally). Anterior coxae greatly enlarged. Dorsal abdominal pattern consisting 7 longitudinal rows of sclerites, each of which bears one of two hairs only. Length of siphunculus (48μ) about as long as wide (45μ). Cauda knobbed. Anal plate deeply bilobed.

MATERIAL : 8 specimens on *Trifolium alexandrinum*, in May 1957, Koubba Palace (authors' coll.).

II. Sub-Family THELAXINAE

Represented in Egypt by one genus only namely *Anoecia* Koch.

Genus ANOECIA Koch

(Type : *Aphis corni* Fab.)

1857. *Aneocia* Koch, Die Pflanzenläuse Aphiden, p. 275.

Head covered with many hairs and not divided ; front somewhat rounded ; eyes prominent but not distinctly set off from the head. Antennae 6-segmented, armed with sub-circular, oval or elongate rhinaria and covered with hairs. Fore wing with M once branched, stigma short, thick and rounded ; hind wing with both M and Cu present. Siphunculi situated on broad hairy cones. Cauda and anal plate somewhat rounded.

Represented in Egypt by one species only namely *Anoecia corni* Fab.

Anoecia corni (Fabricius)

1775. *Aphis corni* Fab., Systema Ent., Fluesburgi et Lipsiae, Korte, p. 832.
1915. *Anoecia willcocksi* Theo., *Bull. Ent. Res.*, VI, p. 103.
1926. *Anoecia corni*, Hall, Tech. and Sc. Serv., Bull. 68, Min. Agr. Egypt.

First recorded in Egypt by WILLCOCKS on wheat roots in 1909. Redescribed by THEOBALD (1915). WILLCOCKS (1922) and HALL (1926),

both stated that this species possesses a great variation in the number
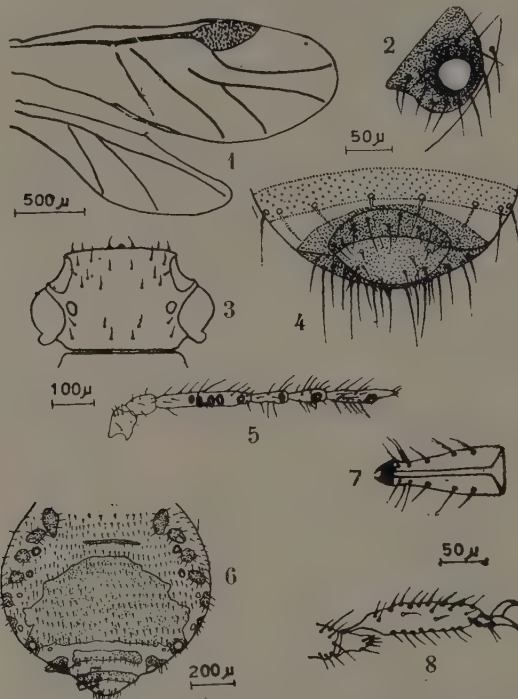of rhinaria in both alate and apterous forms.

FIG. 7: *Anoecia corni* (F.). — 1. Fore and hind wings; 2. Siphunculus;
3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna;
6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind
tarsus.

Antennal formula 3-6-5-4 ; unguis very short, about $\frac{1}{3}$ the length
of the basal part ; number of rhinaria on 3rd and 4th antennal seg-
ments is 7 ranging 5-9 and 2 ranging 1-2 oval rhinaria, respectively.
Apical rostral segment with 6 secondary hairs. Wing venation typical
to that of the genus. First hind tarsal segment with 5 hairs. Abdomen
clothed dorsally with numerous setae ; lateral sclerites present with
setae ; a dorsal patch extends from the end of the 3rd segment to the
6th. Siphunculi hairy, slightly projecting with round openings, and
surrounded with pigmented area attached with the abdominal patch.
Seven lateral abdominal sclerites present.

MATERIAL : One specimen caught on a light trap, 13 March 1958,
Koubba Palace (authors' coll.), and another one on roots of wheat,
21 May 1924, Gezireh (coll. Min. Agric.).

III. Sub-Family ERIOSOMATINAE

Head and pronotum of apterae distinct. M of fore wing once branched or simple. Tarsal hairs normal, short and pointed. Siphunculi present or absent. Cauda rounded. Usually on roots, rarely in woolly masses on the aerial part. Living in temperate regions. Sexuales not having functional mouth parts.

Represented in Egypt by four tribes namely : *Eriosomatini*, *Fordini*, *Baizongiini*, and *Pemphigini*.

KEY OF THE TRIBES

1(2) Secondary rhinaria annular. Siphunculi present as truncated cones or as evident rings. Wax plates present and often consisting of a ring of cells surrounding an open space ... *Eriosomatini*
— Secondary rhinaria, round, oval or transverse oval and rarely annular   2
2(1) First tarsal segments with only 2 or 3 hairs. Wax plates present, consisting of a solid plate of cells 3
— First tarsal segments often with more than 3 hairs. Wax plates absent   ... ... *Fordini*
3(2) Secondary rhinaria oval, round, or transverse oval, but usually not narrow. Wax plates without hairs. On monocotyledons ... ... *Baizongiini*
— Secondary rhinaria strongly transverse and narrow, encircling 0.5 or more of the circumference of the segment. Mostly on dicotyledons but sometimes on grass roots ... ... *Pemphigini*

1.   Tribe ERIOSOMATINAE

Represented in Egypt by two genera only, namely *Eriosoma* and *Tetraneura*.

KEY OF THE GENERA

1. Fore wing with M once branched ; hind wing with 2 oblique veins ... ... *Eriosoma* Leach
— Fore wing with M simple ; hind wing with one oblique vein ... ... *Tetraneura* Hartig

Genus ERIOSOMA Leach.

(Type : *Aphis lanigera* Hausmann)

1818. *Eriosoma* Leach, *Trans. Hort. Soc. London,* III, p. 60.
1831. *Myzoxylus* Blot, *Mém. Soc. Roy. Agr. et Com. Caen,* III, p. 332.
1837. *Schizoneura* Hartig, *Jahresb. Fortschr. Forstwise. und Forstl. Naturk.,* I,
     p. 645.
1848. *Mimaphidus* Rondani, *Nuovi Annali delle Scienze Naturali,* ser. 2, IX, p. 35.

Antennae 6-segmented with annular rhinaria. Fore wing with M
simple or once branched ; hind wing with both Cu and M present.
Cauda and anal plate rounded. Siphunculi ; distinct rings on some-
what elevated tubercles. Forms living in gall-like formations or caus-
ing excrescenes on their hosts.

Respresented in Egypt by one species only, namely *Eriosoma
lanigera* (Hausm.).

Erisoma lanigera (Hausmann)

1802. *Aphis (Schizoneura) lanigera* Hausmann, *Illig. Mag.,* I, p. 440.
1803. *Coccus mali* Bingley, *Anim. Biog.,* III, p. 200.
1824. *Erisoma mali* Blot, *Mém. Soc. Linn. Caluados,* I, p. 114.
1879. *Schizoneura americana* Riley, *Bull. U.S. Geol. and Geog. Survey,* V.
     pp. 4-9.
1909. *Erisoma lanigera* Theobald, Insect Pests of Fruit, p. 141.

A cosmopolitan pest of apple, commonly named as "Woolly apple
aphid". Recorded in Egypt by WILLCOCKS (1922) and HALL (1926) on
apple trees in Upper Egypt.

Antennal formula 3-5-4-6 ; unguis very short, about one third as
long as basal part. Number of annular secondary rhinaria on 3rd,
4th and 5th antennal segments is 15 ranging 13-18, 4 ranging 3-6, and 3.5
ranging 3-4, respectively. Fore wing with 5 hairs along the R under
the stigma. First hind tarsal segment with 2 hairs only.

MATERIAL : 3 specimens on *Malus* sp., Sep. 1944, Kingsteignton,
Devon (British Museum, 1952 — 176).

Genus TETRANEURA Hartig.

(Type : *Aphis ulmi* L.).

1838. *Byrsocrypta* Holiday, after Eastop (1958), Colonial Office, Hull Printers,
     London.
1841. *Tetraneura* Hartig, *Germar's Zeitschrift für die Entomologie,* III, p. 366.

Antennae 6-segmented armed with narrow annular rhinaria almost
completely encircling the segment. Fore wing with M simple ; hind

wing with only M present. Siphunculi very slightly elevated rings, not at all prominent. Forms living in galls and migrating in spring to other plants.
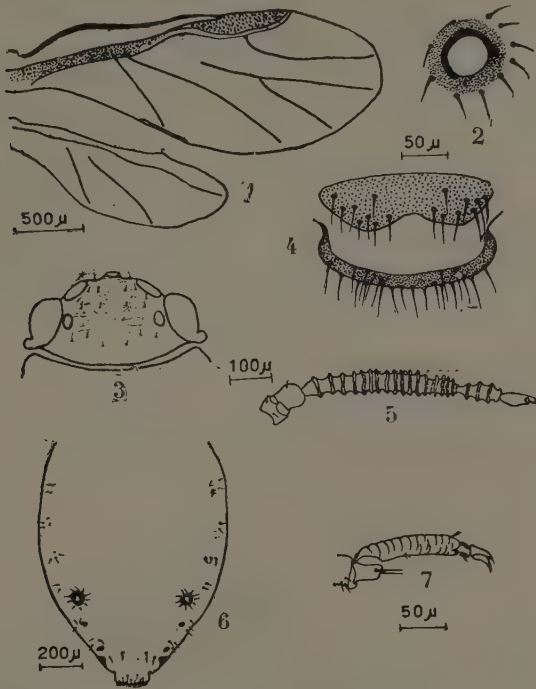

FIG. 8: *Eriosoma lanigera* (Hausm.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Hind tarsus.

HALL (1926) gave two species belonging to this genus, namely *T. cynodontis* Theo. and *T. aegyptiaca* Theo. Unfortunately specimens of both these species were not available to the writer but their brief description according to what is written in literature is given herebelow.

Tetraneura cynodontis Theobald

1922. *Tetraneura cynodontis* Theo., *Bull. Soc. Roy. Ent. Egypte*, VII, p. 39.
    Described from samples found in Egypt on the roots of *Cynodon dactylon*.

Antennae 6-segmented with irregular transverse or elongate oval rhinaria ; antennal formula (3-5)-6-4 ; unguis less than as long as basal part ; number of rhinaria on 3rd, 4th and 5th antennal segments ranging 7-10, 3-4 and 8-10, respectively.   Wax plates present.

Tetraneura aegyptiaca Theobald

1922. *Tetraneura aegyptiaca* Theo., *Bull Soc. Roy. Ent. Egypte*, VII, p. 39.

Described from samples found in Egypt on roots of *Panicum* sp.

Antennae 6-segmented with broken and complete transverse rhinaria ; antennal formula 3-5-6-4 ; unguis short less than half the basal part ; number of rhinaria on 3rd, 4th and 5th antennal segments is 12, 3 and 6, respectively.   Rostrum short.   Siphunculi short, ring-like.

The present writers however have recorded a third species which was kindly identified by Dr. EASTOP of the British Museum as *T. hirsuta* (Baker)
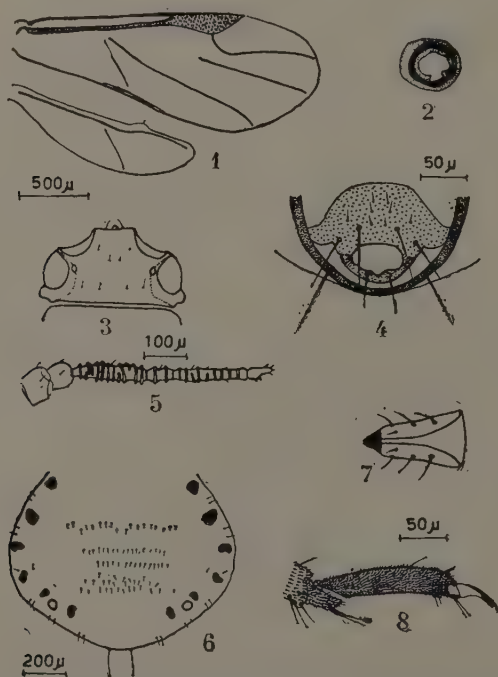

FIG. 9: *Tetraneura hirsuta* (Baker). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Tetraneura hirsuta (Baker)

1921. *Tetraneura hirsuta* (Baker), Eastop (1958), Coolonial Office, Hull Printers Ltd., London.

The writers record this species for the first time in Egypt on flowers of *Caryopsis grandiflora.*

Antenna 6-segmented with annular rhinaria ; antennal formula 3-5-4-6 ; number of rhinaria on 3rd and 4th antennal segments 12 ranging 11-14 and 4 ranging 2-4, respectively ; 5th antennal segment with 10 ranging 8-12 annular rhinaria on one side only. Apical rostral segment with 2 secondary hairs. The two segments of the tarsus are clothed with minute hairs ; first hind tarsal segment with 2 long hairs. Siphunculi ring-like. Cauda and anal plate rounded.

MATERIAL : Four specimens caught on the light trap, May 1958, and one on *Caryopsis grandiflora,* May 1957, Koubba Palace (authors' coll.).

2. Tribe FORDINI

Represented in Egypt by one Sub-Tribe "Fordini" characterised by the primary rhinaria being non-ciliated. It is also represented in Egypt by one genus only namely *Geoica* Hart.

Genus GEOICA Hart.

(Type : *Geoica squamosa* Hart.)

1860. *Tychea* Passerini, Gli Afidi, p. 30.
1894. *Geoica* Hart, 18th Report. State Ent., III, p. 101.
1906. *Tycheoides* Schouteden, *Mém. Soc. Ent. Belg.,* XII, p. 194.
1906. *Kaltenbachiella* Schouteden, *Mém. Soc. Ent. Belg.,* XII, p. 194.
1909. *Trifidaphis* Del Guercio, *Rivista Patol. Vegetale* (N.S.), III, p. 332.
1912. *Tullgrenia* V. d. Goot, *Tijdsch. voor Ent.,* XV, p. 96.
1913. *Trinacriella* Del Guercia, *Redia,* IX, p. 169.
1916. *Serrataphis* V. d. Goot, Zur Kenntniss der Blattläuse Java's, p. 263.

Antennae usually 6-segmented. Fore wings with M simple ; hind wings with both M and Cu present, though faintly indicated and obscure in mounted specimens. Cauda large and somewhat rectangular or rounded. Subterranean forms living on the roots of plants.

Represented in Egypt by two species only namely *Geoica spatulata* Theo. and *G. phasoli* Pass., the former of which was unfortunately inavailable to the writer but the description as collected from literature is briefly as follows.

KEY TO THE SPECIES

1. Unguis about half as long as the basal part ... ... *spatulata* Theo.
—   Unguis about fifth as long as the basal part ...   *phaseoli* Pass.

Geoica spatulata Theobald

1922. *Geoica spatulata* Theo., *Bull. Soc. Roy. Ent. Egypte*, VII, p. 39.

Described from samples found in Egypt on the roots of *Panicum* sp. (WILLCOCKS' collection).

Body with many hairs. Antennal formula 3-6-4-5 ; unguis about half as long as the basal part ; number of rhinaria on 3rd and 4th antennal segments 3 and 2, respectively. Cauda and anal plate rounded.

Geoica phaseoli (Passerini)

1860. *Tychea phaseoli* Pass., Gll Afidi, p. 39.

1860. *Geoica phaseoli* Pass., after Hall (1926), Tec. and Sc. Serv., Min. Agr. Egypt, Bull. 68, pp. 1-62.

Identified and redescribed by THEOBALD (1915) from specimens found on bean roots, *Brassica, Euphorbia* and *Amaranthus* (WILLCOCKS' coll.). WILLCOCKS (1922) and HALL (1926) added roots of cotton seedlings, barley, wheat, tomato, sedge, *Portulaca* sp. and orobanche grawing on tobacco roots as new host plants.
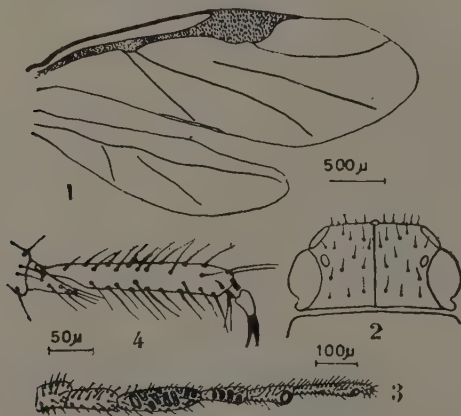

FIG. 10: *Geoica phaseoli* (Pass.). — 1. Fore and hind wings; 2. Head (dorsal view); 3. Antenna; 4. Hind tarsus.

Antennae 6-segmented with rhinaria variable in size ; antennal formula 3-6-(4-5) ; unguis about 1/5th the basal part ; number of rhinaria on 3rd and 4th antennal segments 10 and 4, respectively.

MATERIAL : One specimen on orobanche on tobacco roots, 20 Jan. 1924, Giza (coll. Min. Agric.).

3.   Tribe BAIZONGIINI

Secondary rhinaria of this group are ciliated, a character also found in *Geoica* (*Fordini*).

Represented in Egypt by two genera only namely *Aploneura* Pass. and *Asiphoniella* Theo.

KEY TO THE GENERA

1.   A single rhinarium present usually on each of 3rd to 6th antennal segments ... ... *Aploneura* Pass.
—   More than a single rhinarium present usually on both 3rd and 4th antennal segments   ... ... *Asiphoniella* Theo.

Genus APLONEURA Passerini

(Type : *Tetraneura lentisci* Pass.)

1848. *Baizingia Rondani, Nuovi Annali Scienze Naturali,* IX, p. 35.
1863. *Aploneura* Pass., Aphididae Italicae, p. 78.
1869. *Tetranema* Derbès, *Ann. Sc. Nat. Zool.* (5), XI, p. 106.

Body elongate, less than $\frac{2}{3}$ as broad as long. M of fore wing simple, Cu and A joined near their bases ; hind wing with only M present. Antennae usually with only a single rhinarium on each of segments 3rd to 6th. Hairs on first tarsal segments short, less than half as long as the segment. Lateral abdominal hairs inconspicuous. Siphunculi absent. Forms living in true galls.

Represented in Egypt by one species only, namely *Aploneura lentisci* Pass.

Aploneura lentisci (Passerini)

1863. *Tetraneura lentisci* Pass., Aphididae Italicae, p. 78.
1863. *Aploneura lentisci* Pass., after Bodenheimer (1926), *Bull. Soc. Ent. Egypte,* XIX, pp. 64-88.

First identified and redescribed by THEOBALD (1915) from samples living on various grass roots and wheat (WILLCOCKS' collection) under the name *Rhizobius graminis* Buckton.

The writers collected specimens, from a light trap, which were
kindly identified by Dr. EASTOP of the British Museum.   The writers
examined HALL's specimens for *Rhizobius graminis* and were convinced
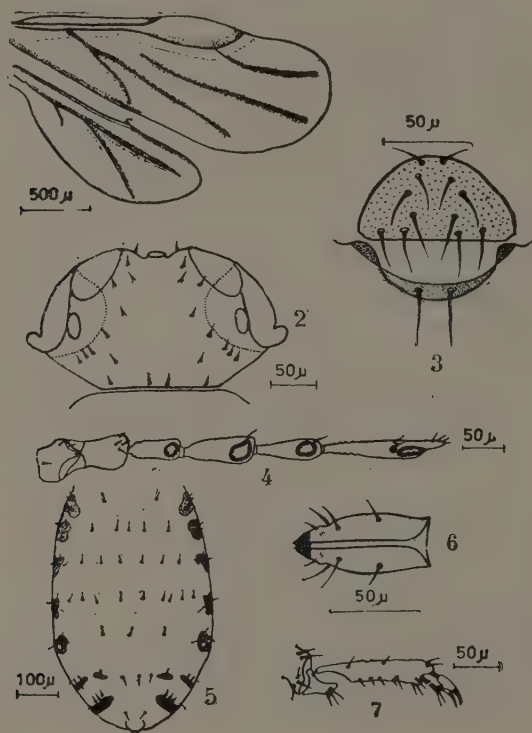that it is a synonym to *Aploneura lentisci*.

FIG. 11: *Aploneura lentisci* (Pass.). — 1. Fore and hind wings; 2. Head (dor-
sal view); 3. Cauda and anal plate (ventral view); 4. Antenna; 5. Abdomen
(dorsal view); 6. Apical rostral segment (dorsal view); 7. Hind tarsus.

Antennal formula 6-5-3-4 ; unguis about one-third as long as the
basal part ; a single, large, ciliated rhinarium on each of antennal seg-
ments 3rd to 6th.   Apical rostral segment with 2 secondary hairs.
First hind tarsal segment with 3 hairs.

MATERIAL : 10 specimens caught on a light trap, Apr. 1958, Koubba
Palace (authors' coll.) ; and 5 specimens on roots of wheat, March 1924,
Giza (coll. Min. Agric.).

Genus ASIPHONELLA Theobald

(Type : *Asiphonella dactylonii* Theo.)

1922. *Asiphonella* Theo.; *Bull. Soc. Roy. Ent. Egypte*, VII, p. 39.

Head bears one pair of wax plates and the thorax is apparently without these plates. Abdominal segments 1 to 6 of the alatae have only small dorsal and lateral wax plates, the pleural plates are apparently absent ; the 7th tergite has a pair of large pleural plates in addition to the dorsal and lateral plates ; the 8th tergite has 2 pairs of large plates, the lateral pair being transversely elongate and perhaps representing the fusion of the lateral pleural plates (EASTOP, 1958). Fore wing with M simple, hind wing with M and Cu present. Antennae with ciliated rhinaria.

Represented in Egypt by one species only namely *Asiphonella dactylonii* Theo.

Asiphonella dactylonii Theobald

1922. *Asiphonella dactylonii* Theo., *Bull. Soc. Ent. Egypte*, VII, p. 39.
1944. *Paraprociphilus graminis* Blanchard, after Eastop (1958), Colonial Office, Hull Printers Ltd., London.

Described from Egypt from samples found by WILLCOCKS. HALL (1926) could not collect this species, which was also inavailable to the present writers. Description as collected from literature is briefly as follows :

Antennal formula (3-6)-5-4 ; unguis about half as long as the basal part ; number of secondary rhinaria on 3rd and 4th segments is 7 and 2, respectively. Rostrum short. Fore wing with M simple ; hind wing with M and Cu present. Legs rather long, thin ; tibiae slightly expanding apically. Siphunculi absent. Cauda rounded bearing short hairs. Wax plates present.

4.   Tribe PEMPHIGINI

Antennae 6-segmented almost armed with linear, oval, or somewhat irregularly shaped rhinaria. Small wax secreting areas present. Forms usually inhabiting true galls and often migrating to other plants during the summer.

Represented in Egypt by two genera only, namely *Pemphigus* Hartig and *Phloemyzus* Horvath.

<div align="center">KEY TO THE GENERA</div>

1. Fore wing with M once branched ... ... *Phloemyzus* Horvath
— Fore wing with M simple ... ...*Pemphigus* Hartig

<div align="center">

Genus PHLOEMYZUS Horvath

(Type : *Schizoneura passerinii* Sig.)
</div>

1886. *Löwia* Liehtenstein, Mon. Puceron Peupl., p. 37.
1896. *Phloeomyzus* Horvath, *Wien. Ent. Zeit.*, XV, p. 5.

Antennae 6-segmented, slender and without secondary rihnaria. Fore wing with M once branched ; hind wing with both M and Cu present. Large wax plates present on the abdomen. Siphunculi present, very slightly elevated. Wings held flat in repose.

Represented in Egypt by one species only, namely *P. passerinii* Sign.

<div align="center">

Phloeomyzus passerinii Sign.
</div>

1926. *Phloeomyzus passerinii* Sign., after Hall, Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68, pp. 1-62.

First recorded and redescribed in Egypt by HALL (1926) on poplar. Specimens of this species were inavailable to the present writers. HALL's redescription for this species is briefly as follows.

Antennae 6-segmented, slender without secondary rhinaria. Wax plates present on the abdomen. Siphunculi very small and inconspicuous. Anal plate bilobed.

<div align="center">

Genus PEMPHIGUS Hartig

(Type : *Aphis bursaria* L.)
</div>

1837. *Pemphigus* Hartig, *Jahresb. Fortschr. Forstwise. und Forstl. Naturk.*, I, p. 645.
1839. *Byrsocrypta* Holiday, *Ann. Nat. Hist.*, II, p. 190.
1840. *Brysocrypta* Westwood, Int. Mod. Class. Ins., Synopsis, II, p. 118.
1847. *Aphioides* Rondani, Nuovi Annali Sci. Nat. Bologna (2), VIII, p. 439.
1857. *Amycla* Koch, Die Pflans. Aphiden, p. 301.
1857. *Pachypappa* Koch, Die Pflans. Aphiden, p. 269.
1857. *Rhizomaria* Hartig, *Verhandl. Hils-Solling-Forstversins*, Jahrag. 1856, p. 52.
1859. *Tychea* Koch, Die Pflanzenlaüse Aphiden, p. 296.
1885. *Kessleria* Lichtenstein, Mon. Puceron du Peuple, p. 16.
1904. *Hamadryaphis* Kirkaldy, *The Entomologist*, XXXVII, p. 279.

Antennae 6-segmented with narrow, oval or somewhat irregular rhinaria. Fore wing with the M simple ; hind wing with both M and Cu present. Siphunculi present. Wax plates if present, weakly developed.

Represented in Egypt by one species only, namely *Pemphigus globulosus* Theo.

Pemphigus globulosus Theobald

1915. *Pemphigus globulosus* Theo., *Bull. Ent. Res.*, VI, p. 103.

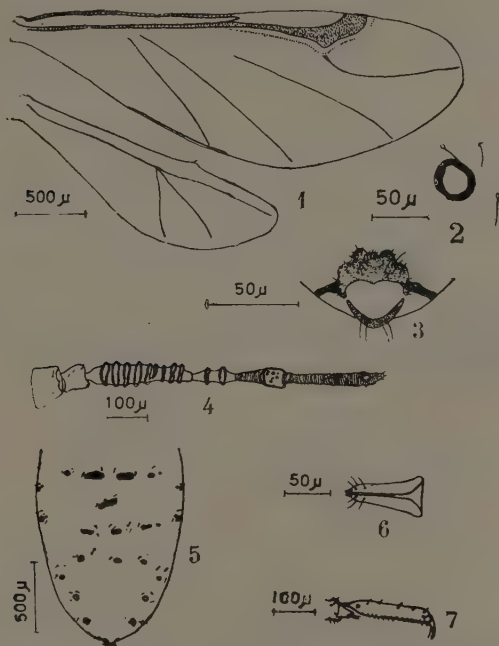Described from samples found in Egypt on *Populus* sp. (WILLCOCKS' collection).

FIG. 12: *Pemphigus globulosus* Theo. — 1. Fore and hind wings; 2. Siphunculus; 3. Cauda and anal plate (ventral view); 4. Antenna; 5. Abdomen (dorsal view); 6. Apical rostral segment (dorsal view); 7. Hind tarsus.

Antenna 6-segmented with irregular rhinaria; antennal formula 3-6-5-4; unguis about one-fifth as long as the basal part; number of secondary rhinaria on 3rd and 4th antennal segments is 10 ranging 9-11 and 2.5 ranging 2-3, respectively. Apical rostral segment without secondary hairs. First hind tarsal segment with 2 hairs.

MATERIAL : 2 specimens, on *Populus albus*, 1 Aug. 1920, Aga-Dakahlia (coll. Min. Agric.).

IV. Sub-Family LACHNINAE

Body large, entirely clothed with hairs. Compound eyes large, when reduced the hind tarsi greatly elongated. Antennae usually

6-segmented and bearing numerous conspicuous hairs; unguis short, less than half as long as the basal part; secondary rhinaria circular. First tarsal segments usually with numerous hairs. Wing venation usually normal, sometimes reduced. Siphunculi usually situated on distinct hairy cones. Cauda and anal plate rounded.

Represented in Egypt by three sub-tribes, namely *Cinarina* (tribe *Cinarini*), *Lachnina* (tribe *Lachnini*) and *Eulachnina* (tribe *Eulachnini*).

KEY TO THE SUB-TRIBES

1(2) Rostrum normal in length, shorter than the body 2
— Rostrum very long, much longer than the body ... ... *Cinarina*
2(1) Form elongate and very narrow. Antennae without secondary rhinaria. Siphunculi not hairy. Triommatidion absent ... ...
... ... *Eulachnina*
— Form not elongate. Antennae with secondary rhinaria. Siphunculi on hairy cones. Triommatidion present ... ... *Lachnina*

1. Tribe CINARINI

Sub-Tribe *Cinarina*

Eyes large. Rostrum very long, much longer than body. Apical rostral segment long and pointed, distinctly divided into segments IV and V. R_s of fore wing straight and short. All 2nd tarsal segments similar and normal in shape. Usually present on the twigs and branches, rarely on the needles of *Coniferae*.

Represented in Egypt by one genus to which belongs one species, namely *Cinara thujafilina* (Del Guercio).

Cinara thujafilina (Del Guercio)

1909. *Cinara thujafilina* (Del Guercia), after Eastop, 1958, Colonial Office, Hull Printers Ltd., London.
1913. *Lachniella thujafolia* Theo., *Bull. Ent. Res.*, IV, p. 313.
1926. *Dilachnus thujafolia* Hall, Tech. and Sc. Serv., Min. Agric. Egypt, Bull. No. 68, pp. 1-62.
1934. *Cinara winonkae* Hottes, after Eastop (1958), Colonial Office, Hull Printers L*d., London.

First identified in Egypt by THEOBALD (1922) on *Thuja orientalis*. HALL (1926) redescribed the alate viviparous females in detail and gave drawings for the wing and the antenna.

Head divided. Antennal formula 3-(5-6)-4 ; unguis very short about ⅙ the basal part ; number of rhinaria on 3rd, 4th and 5th segments is 3 ranging 1-4, 1.5 ranging 1-2, and 2 ranging 2-3, respectively. First hind tarsal segment with 6 hairs ; 2nd hind tarsal segment long. Apical rostral segment with 6 secondary hairs. Width of siphunculi (189 μ) about 1.5 times as long as the length (125 μ).

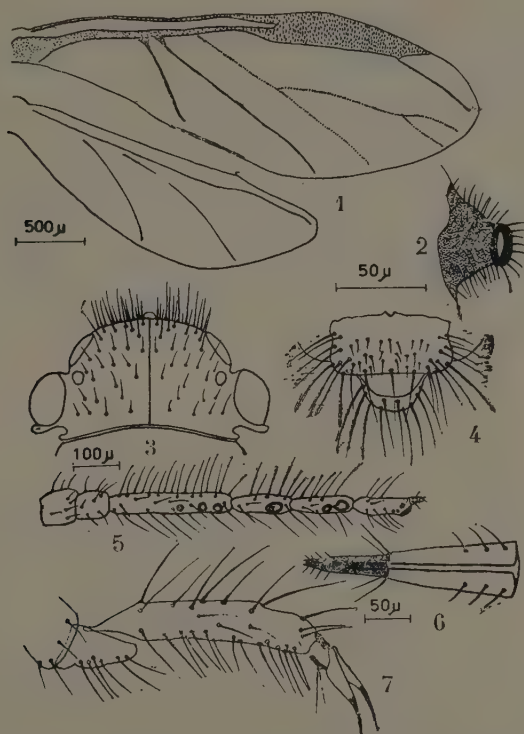MATERIAL : 10 specimens on *Thuja orientalis*, April 1924, Giza (coll. Min. Agric.).

FIG. 13: *Cinara thujafilina* (del Guercio). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Apical rostral segment (dorsal view); 7. Hind tarsus.

2. Tribe EULACHNINI

Sub-Tribe *Eulachnina*

Body very elongate and slender, scarcely wider than the head. Eyes large and set off from the head ; triommatidion not visible.

Antennae slender, armed with bristles or spines and not with slender hairs. Siphunculi minute and not on distinct hairy cones. Cauda abruptly rounded.

Represented in Egypt by one genus only, namely *Eulachnus* Del Guercio.

Genus EULACHNUS Del Guercio

(Type : *Lachnus agilis* Kalt.)

1909. *Eulachnus* Del Guercio, *Rivista Patol. Vegetale* (N.S.), III, p. 329.
1915. *Protolachnus* Theo., *Bull. Ent. Res.*, VI, p. 145.

Body narrow and rather long. Head divided ; eyes rather large and outstanding. Antennae 6-segmented, thin, shorter than body, and armed with long stout bristles. Rostrum long and blunt. Fore wing with M faintly indicated and once branched ; hind wing with both M and Cu present and faint. Siphunculi minute, not situated on hairy cones. Cauda abruptly rounded. Stemmata tuberculate.

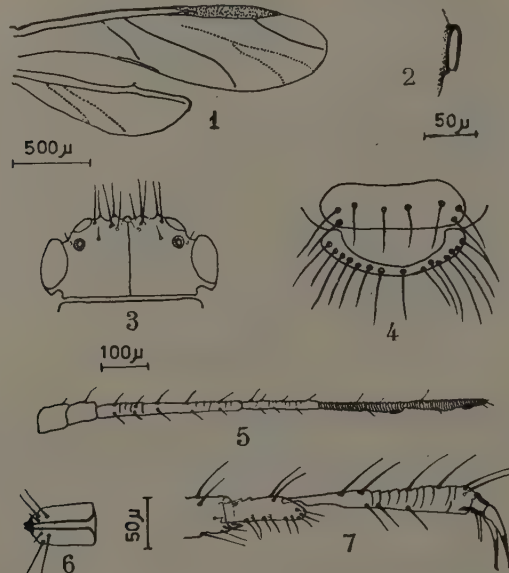Represented in Egypt by one species only, namely *Eulachnus tuberculostemmata* Theo.

Fig. 14: *Eulachnus tuberculostemmata* (Theo.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Apical rostral segment (dorsal view); 7. Hind tarsus.

Eulachnus tuberculostemmata (Theobald)

1915. *Protolachnus tuberculostemmata* Theo., *Bull. Ent. Res.*, VI, p. 103.
1926. *Eulachnus tuberculostemmata* Hall, Tech. and Sc. Serv., Min. Agr. Egypt,
      Bull. 68, pp. 1-62.

Described from samples found in Egypt on *Pinus* sp. and placed in the genus *Protolachnus*.

Antennal formula 3-5-6-4 ; antennal segments without secondary rhinaria, but armed with long stout bristles ; primary rhinaria present on 5th and 6th antennal segments ; unguis very short about 1/5 as long as the basal part. Apical rostral segment without secondary hairs. First hind tarsal egsment with 9 hairs.

MATERIAL : 2 specimens on Pinus sp., April 1932, Alexandria (coll. Min. Agric.).

3.   Tribe LACHNINI

Eyes large. R$_s$ of fore wing curved and of moderate length. All 2nd tarsal segments similar and normal in shape. Apical tarsal segment always blunt. Usually on dicotyledons, when on Coniferae, rostrum much longer than the body.

Usually on the aerial parts of trees.

Sub-Tribe *Lachnina*

Rostrum normal in length, shorter than the body.

Usually on the aerial parts of dicotyledons, never on Coniferae.

Represented in Egypt by two genera namely *Tuberolachnus* and *Pterochloroides*, each represented by one species only namely *T. saligna* (Sulzer) and *P. persicae* (Cholodkovsky).

KEY TO THE SPECIES

1.   Abdomen bears a single mid-dorsal tubercle ... *T. saligna* (Sulz.)
—   Each of the anterior 6 abdominal segment bears a pair of dark
     tubercles   ... ... *P. persicae* (Cholod.)

Tuberolachnus saligna (Sulzer)

1761. *Aphis saligna* Sulzer, Ins., pl. 2, fig. 6
·1800. *Aphis calicis* Curtis, *Trans. Linn. Soc.*, VI, p. 75, pl. 5, figs. 1 and 2.
1840. *Aphis salicina* Zetterstedt, Ins. Lapp., I, p. 311.
1841. *Aphis viminalis* Boyer de Fonscolombe, *Ann. Soc. Ent. Fr.*, X, p. 184.
1841. *Lachnus viminalis*, after Theobald (1915), *Bull. Ent. Res.*, VI, p. 103.
1926. *Pterolachnus viminalis* Hall, Tech. and Sc. Serv., Min. Agric. Egypt., Bull.
      68, pp. 1-62.
1926. *Tuberolachnus saligna*, after Eastop (1958), Colonial Office, Hull Printers
      Limited, London.

Identified by THEOBALD (1915) from samples found in Egypt on *Salix* sp. (WILLCOCKS' collection).
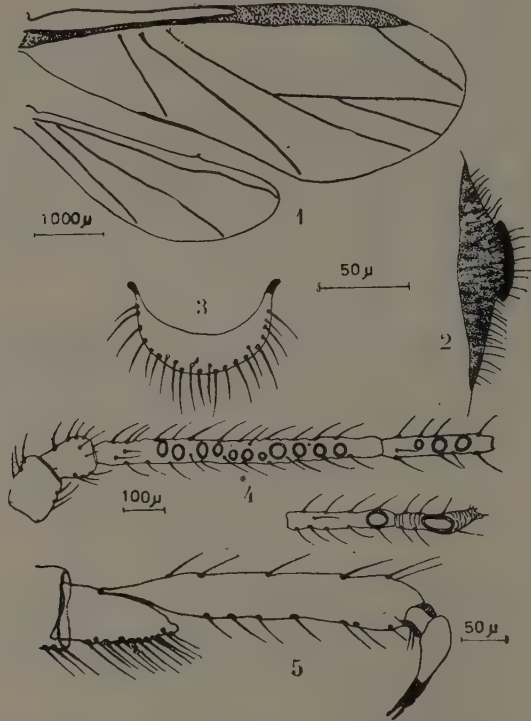

FIG. 15: *Tuberolachnus saligna* Sulzer. — 1. Fore and hind wings; 2. Siphun-culus; 3. Cauda and anal plate (ventral view); 4. Antenna; 5. Hind tarsus.

Antennal formula 3-(4-5-6) ; unguis slightly less than half as long as basal part ; number of rhinaria on 3rd and 4th antennal segments is 9.5 and 2.5 respectively ; 5th antennal segment without secondary rhinaria. First hind tarsal segment with numerous hairs (12) ; 2nd hind tarsal segment long, longer than the 6th antennal segment. Length of cauda equal to its width (165μ). This species is characterised by the presence of a single mid-dorsal tubercle on the abdomen.

MATERIAL : One specimen on willows, 15 Oct. 1914, Johannesburg (B.M.).

Pterochloroides persicae (Cholodkovsky)

1899. *Lachnus persicae* Cholodkovsky, *Zool. Anz.,* p. 472.
1913. *Dryaphis persicae* Theobald, *Bull. Ent. Res.,* IV, p. 335.
1926. *Pterochlorus persicae* Hall, Tech. and Sc. Serv., Min. Agr. Egypt., Bull. 68, pp. 1-62
1926. *Pterochlorcides persicae,* after Eastop (1958), Colonial Office, Hull Printers Limited, London.

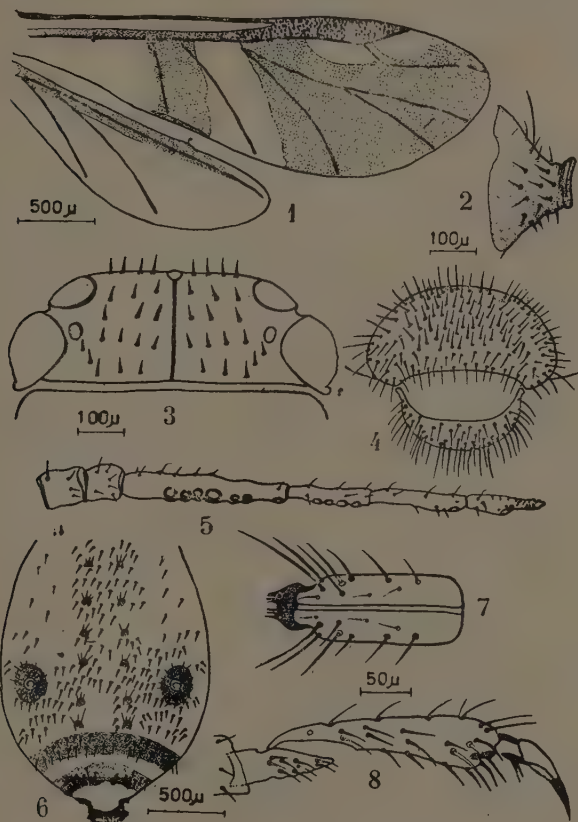Fig. 16: *Pterochloroides persica* (Cholod.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view), 8. Hind tarsus.

Identified by Theobald (1913) from samples found in Egypt on peach, apple, apricot, pear and plum (Willcocks' collection). Hall (1926) collected it from oranges.

Antennal formula 3-5-4-6 ; unguis slightly less than half the basal part ; number of rhinaria on 3rd and 4th antennal segments 9 ranging 6-11 and 3 ranging 3-4, respectively ; 5th antennal segment without secondary rhinaria. Apical rostral segment with 14 secondary hairs. First hind tarsal segment with 8 hairs ; 2nd hind tarsal segment moderately long, twice as long as the cauda. Each of the anterior 6 abdominal segments bears a pair of small dark tubercles.

MATERIAL : 6 specimens on peach, Jan. 1921, Facous (coll. Min. Agric.).

V. Sub-Family APHIDINAE

Compound eyes large and many faceted. Antennae, slender, sometimes 5, usually 6-segmented ; unguis slender and elongate, usually longer than the basal part, often considerably so ; secondary rhinaria sub-circular. First tarsal segments with 2-5 ventral hairs and without dorsal hairs ; second tarsal segments with only short, pointed dorsal hairs like, often about three-quarters as long as the claws. Wing venation often normal but sometimes the M of the fore wing is only once-branched ; the hind bears two, one or no oblique veins. Siphunculi present, usually longer than their basal width and more or less cylindrical, tapering or clavate. Cauda usually elongate, but sometimes rounded. Insect not usually hairy.

Mostly free-living on the aerial parts or the roots of plants, but some species distort the leaves to form pseudo-galls.

KEY TO THE TRIBES

1. Lateral abdominal tubercles usually absent from the 1st and 7th abdominal segments and variably present on segments 2 to 6. If present on 1 and 7 then not larger than those on 2 to 6 which are then always present. Spiracles of abdominal segments 1 and 2 usually close together and characterised by their pigmented areas. Frontal tubercles often well developed. Abdomen often with a dorsal black patch. Antennal hairs often long and somewhat capitate, but in many genera small and inconspicuous ....
    ... ... *Macrosiphini*
— Lateral abdominal tubercles present on segments 1 and 7 and larger than those on 2 to 6 which may be absent. When very rarely the tubercles on 1 and 7 are absent, then they are also absent from 2 to 6. Spiracles of abdominal segments 1 and 2 far apart. Lateral tubercles of 1st segment, if present, are situated

between spiracles of 1st and 2nd abdominal segments. Frontal
tubercles never well developed. Abdomen usually without a solid
black patch on the dorsum, although in a few species the trans-
verrse black bands are partially fused. Some species have no
dorsal abdominal pigmentation. Antennal hairs sometimes long
but never capitate ... ... *Aphidini*

1. Tribe MACROSIPHINI

KEY TO THE GENERA

1(2) 8th abdominal tergum with a supra-caudal process. Siphun-
      culi, long and swollen ... ... *Cavariella* Del Guercio
  —   8th abdominal tergum without a supra-caudal process. Siphun-
      culi variable 2
2(1) Veins of fore wing bordered with fuscous margin ; R$_s$ of fore
      wing either united with the upper branch of the M or not ;
      hind wing normal or much reduced 3
  —   Veins of fore wing not bordered with fuscous margin ; R$_s$ of
      fore wing normal ; hind wing normal 4
3(2) R$_s$ of fore wing deeply curved downward uniting with M thus
      forming a closed cell (at least four sided) ; hind wing with one
      oblique vein ... ... *Pentalonia* Coq.
  —   R$_s$ of fore wing not deeply curved downward and not uniting
      with M ; no closed cell is formed ; hind wing with two oblique
      veins ... ... *Idiopterus* Davis
4(2) All veins with a fuscous triangular region at the margin of the
      wing. Siphunculi very strongly swollen   ... ...
      ... ... *Eucarazzia* Del Guercio
  —   All veins without this fuscous region 5
5(4) Siphunculi with polygonal reticulated apex   6
      Siphunculi without polygonal reticulated apex, sometimes with
      a few connected transverse striae at the apex to give a few
      rows of strong transverse cells   8
6(5) First tarsal segments with 5 hairs ... ... *Dactynotus* Raf.
  —   First tarsal segments with 3 hairs 7
7(6) Abdomen with post-siphuncular sclerite. Apical rostral seg-
      ment blunt ... ... *Macrosiphum* Pass.
  —   Abdomen without post-siphuncular sclerite. Apical rostral
      segment stiletto-shaped (acuminate), often with concave mar-
      gins ... ... *Macrosiphoniella* Del Guercio

8(5) Frontal tubercles strongly converging (projecting inwards) ... 9
—   Frontal tubercles distinctly diverging, or sometimes not well-
      developed   10
9(8) Abdomen with a dorsal sclerotised patch ... ...   *Myzus* Pass.
—   Abdomen without a dorsal sclerotised patch   ... ...
      ... ...   *Rhodobium* H.R.L.
10(8) Abdomen or head (especially frontal tubercles) or basal anten-
      nal segments with capitate hairs   11
—   Abdomen, head and basal antennal segments without capitate
      hairs 12
11(10) 3rd antennal segment often with tuberculate rhinaria, and
      sometimes with capitate hairs   ... ...   *Chaetosiphon* Mordw.
—   3rd antennal segment with non-tuberculate rhinaria and with-
      out capitate hairs 13
12(10) Secondary rhinaria confined to the 3rd antennal segment only
      15
—   Secondary rhinaria present on 3rd and 4th or 3rd, 4th and 5th
      antennal segments   16
13(11) Abdomen with a dorsal rectangular sclerite ... ...
      ... ...   *Capitophorus* V. d. Goot
      Abdomen without a dorsal rectangular sclerite   14
14(13) Siphunculi cylindrical   ... ...   *Pleotrichophorus* Börner
—   Siphunculi clavate   ... ... *Coloradoa* Wilson
15(12) Abdomen without dorsal pigmentation. Siphunculi long   ...
      ... ...   *Acyrthosiphon* Mordw.
—   Admonen with dorsal pigmentation. Siphunculi short 17
16(12) Abdomen without dorsal pigmentation.   *Hyadaphis* Kirkaldy
—   Abdomen with weakly or well-developed dorsal pigmentation
      18
17(15) Siphunculi very short. Cauda semi-circular   ... ...
      ... ...   *Brachycaudus* V. d. Goot
—   Siphunculi short. Cauda triangular.   *Brevicoryne* V. d. Goot
18(16) Abdomen with weakly developed dorsal pigmentation except on
      tergites 6 to 8. Siphunculi weakly clavate, about 1-2 as long as
      the cauda   ... ...   *Lipaphis* Mordw.
—   Abdomen with well-developed abdominal dorsal pigmentation.
      Siphunculi variable in length   19
19(18) Cauda spatulate, constricted near the base. Siphunculi long and
      strongly clavate, distinctly longer than cauda *Nasonovia* Mordw.

— Cauda pentagonal or semi-circular. Siphunculi short and not clavate, about equal or little longer than cauda 20

20(19) Siphunculi tapering. Cauda semi-circular ... ...
... ... *Brachycaudus* V. d. Goot

— Siphunculi cylindrical. Cauda pentagonal *Chomaphis* Mordw.

Genus CAVARIELLA Del Guercio

(Type : *Aphis pastinacae* L.)

1911. *Cavariella* Del Guercio, *Redia*, VII, p. 323.
1914. *Corynosiphon* Mordwilko, Faune de la Russie, Insecta, Aphidodea, p. 73.
1917. *Hipposiphon* Matsumura, *Journ. Coll. Agr. Tohoka Univ.*, VII (6), p. 410.

Living specimens usually green.

Head without distinct antennal tubercles, median tubercle well developed. Antenna 6-segmented, armed with prominent rhinaria. Wing venation normal. Abdomen with a membraneous dorsum bearing a solid black patch which may be sometimes broken into segmentally arranged separate, wide transverse bands ; 8th tergite with a well developed supra-caudal process, which is most prominent in the apterous forms. Siphunculi, cylindrical or more often clavate, and 1/5 to 1/4 as long as the body. Cauda rather elongate, somewhat conical with 6 or 7 hairs.

It is represented in Egypt by two species, namely *C. aegopodii* Scop. and *C. capreae* Fabricius. HALL (1926) believed that the former was wrongly recorded by WILLCOCKS (1922) as *C. capreae*, a mistake which had been committed by himself. The present writers could not also collect *capreae* and so it is not recorded in the present work.

Cavariella aegopodii (Scopoli)

1763. *Aphis aegopodii* Scop., *Entomologica Carniolica*, p. 399.
1910. *Hyadaphis pastinacae* Davis, *Jour. Econ. Ent.*, III (6), p. 493.
1910. *Cavariella aegopodii*, after Hottes and Frison (1931), Dep. Reg., Div. Nat. Hist. Surv., Illinois, (Urbana).

Recorded for the first time in Egypt by WILLCOCKS on fennel (THEOBALD, 1922).

General colour green.

Head black, with black eyes and antennae. Antennal formula 3-6-5-4 ; unguis about 1.3 times as long as the basal part ; rhinaria on 3rd segment about 17 ranging from 11 to 19 ; 4th and 5th segment without secondary rhinaria. Apical rostral segment with only the apical primary hairs (6). Thorax black, but acrotergum green. Wing venation normal. Legs green except the distal parts of the tibia and
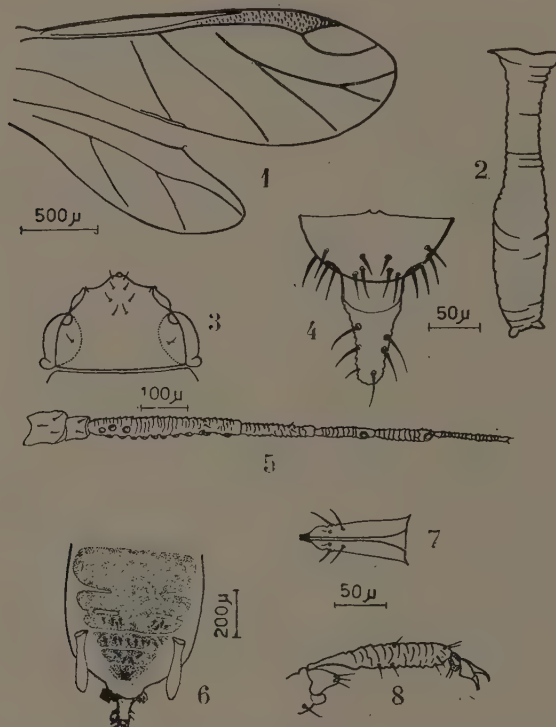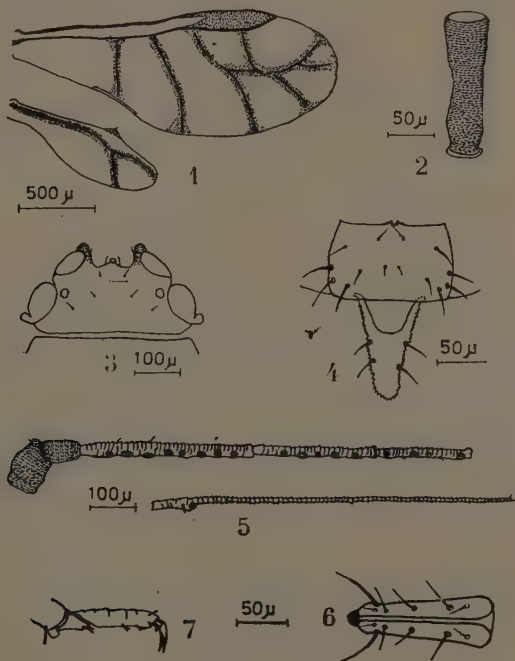

Fig. 17: *Cavariella aegopodii* (Scop.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

tarsus which are black ; first tarsal segment of hind leg with 3 hairs. Abdomen green with a dorsal black patch which may be broken. Siphunculi located in the same plane of the abdomen, converging and swollen at the distal half. Supra-caudal process with 2 hairs. Cauda light dark conical. Genital plate black.

MATERIAL : 10 specimens on fennel, Dec. 1957, Koubba Palace (authors' coll.).

Genus PENTALONIA Coquerel

(Type : *Pentalonia nigronervosa* Coq.)

1859. *Pentalonia* Coquerel, *Ann. Soc. Ent. France*, VII (3), p. 259.

Frontal tubercles prominent, projecting inwards and gibbous especially in the apterous forms. Antennae 6-segmented armed with subcircular rhinaria, and with 1st segment similar to frontal tubercles in being gibbous. Antennal and body hairs, short, clavate and inconspicuous. Apical rostral segment bearing 2-4 secondary hairs and longer than 2nd hind tarsal segment. Wing venation is unlike that of any other genera in the *Aphididae*. Fore wing with R_s extending suddenly downwards to meet the upper branch of the M, and then extending in its natural coarse to the margin of the wing, thus forming a closed cell ; hind wings much reduced with Cu absent. First tarsal segment with 3 : 3 : 2 hairs.

Represented in Egypt by one species only, namely *Pentalonia nigronervosa* Coq.

FIG. 18: *Pentalonia nigronervosa* Coqueral. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Apical rostral segment (dorsal view); 7. Hind tarsus.

Pentalonia nigronervosa Coq.

1859. *Pentalonia nigronervosa* Coq., *Ann. Soc. Ent. France* (3), VII, p. 259.
1917. *Pentalonia caladii* V. d. Goot, Contr. Faune Ind. Néerl., I (3), p. 57-60.

A species common in tropical zones. It attacks Banana and causes a direct damage by sucking its sap besides acting as a carrier of the virus of "Bunchy top" (ZECK and EASTWOOD, 1929).

HALL (1926) collected this species during June, July and September. Its role in carrying the Bunchy top disease was thoroughly studied by KOLKAILA (1953), who gave a thorough morphological redescription to the alate and apterous forms and to the younger instars.

Antennal formula 6-3-4-5 ; unguis 7.5 times as long as the basal part ; number of secondary rhinaria on 3rd, 4th and 5th antennal segments ranges from 6 to 12, 5 to 10, and 3 to 5, respectively. Apical rostral segment with 6 secondary hairs. First hind tarsal segment with 2 hairs.

MATERIAL : 2 specimens on *Musca* sp., 12 June 1922, Maadi ; specimens on *Musca* sp., 19 Nov. 1933, Giza (coll. Min. Agric.).

Genus IDIOPTERUS Davis

(Type : *Idiopterus nephrolepidis* Davis)

1909. *Idiopterus* Davis, *Ann. Ent. Soc. Amer.*, II, p. 198.
1911. *Fullawayella* Del Guercio, *Redia,* VII, p. 462.

Frontal tubercles prominent, slightly projecting inwards and gibbous. Antennae 6-segmented armed with subcircular rhinaria and with first segment similar to the frontal tubercle in being gibbous. Fore wing with R_s extending suddenly downward from the stigma parallel to the upper branch of the M with which it may unite in some specimens ; hind wing with both M and Cu present.

The phenomenon of the union of R_s with M in some specimens and their separation in some others drew the attention of BAKER (1920) who considered the venation of this genus to be intermediate between the genus *Pentalonia* Coq. (where they are always united) and other genera.

Abdomen without dorsal tubercles. Siphunculi subcylindrical and rather slender. Cauda somewhat elongate and conical which bears only 5 hairs.

Represented in Egypt by one species only, namely *Idiopterus nephrolepidi* Davis.

Idiopterus nephrolepidis Davis

1909. *Idiopterus nephrolepidis* Davis, *Ann. Ent. Sec. Amer.*, II, p. 198-199.
1910. *Macrosiphum kirkaldyi* Fullaway, Ann. Rept. Haw. Agric. Expt. Stat., p. 22.
1911. *Fullawayella kirkaldy* Del Guercio, *Redia*, VII, p. 462.

First recorded in Egypt by HALL in 1920 on *Nephrolepis deval-ioides (Polypodiacae)* and *Saintpaulia ionatha (Gesneriaceae)*.
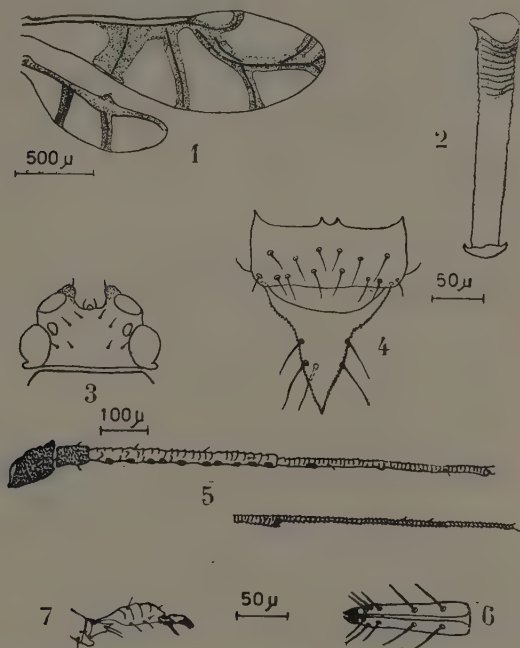

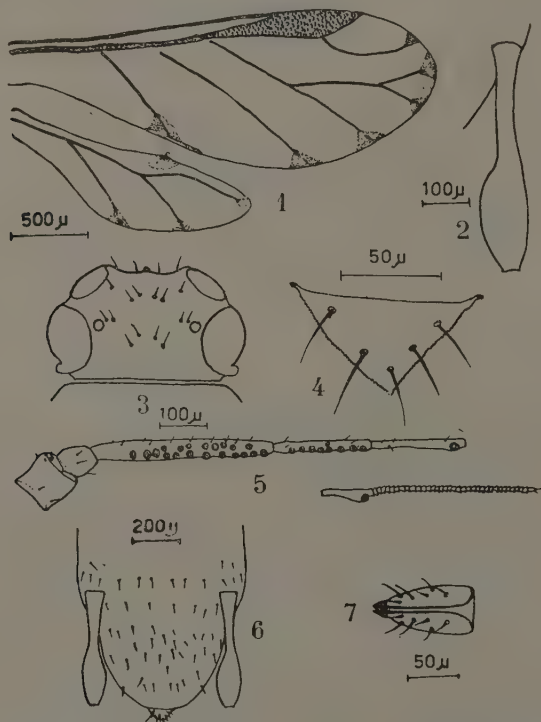FIG. 19: *Idiopterus nephrolepidis* Davis. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Apical rostral segment (dorsal view); 7. Hind tarsus.

Antennal formula 6-3-5-4 ; unguis nearly five times as long as basal part ; number of rhinaria on 3rd and 4th antennal segments ranging from 8-11 and 1-3, respectively ; 5th antennal segment without secondary rhinaria. Apical rostral segment with 4 secondary hairs. Wing venation similar to that given for the genus itself. First hind tarsal segment with 2 hairs. Siphunculi well developed, colourless with a dark basal part measuring about 4/13 their whole length. Cauda short, triangular, acuminate and possessing 5 setae.

MATERIAL : 4 specimens on *Nephrolepis* sp., 20 March 1945, Gezireh (coll. Min. Agric.).

Genus EUCARAZZIA Del Guercio

(Type : *Rhopalosiphum elegans* Ferrari)

1921. *Eucarazzia* Del Guercio, *Redia*, XIV, p. 135.
1920. *Rhopalosiphoninus* Baker, U. S. Dept. Agric., Washington, Bull. 825, pp. 1-93.

Frontal tubercles well developed, very smooth and not converging. Wing venation normal, with veins ending at the margin with a triangular dark region, but without fuscous borders. First tarsal segment with 3 hairs in all legs. Abdominal tergum with a central sclerite. Siphunculi very strongly swollen with few rows of polygonal reticulation at apex. Cauda minute and rather acute, bearing 5 to 7 hairs.

Represented in Egypt by one species only, namely *Eucarazzia elegans* (Ferrari).

Fig. 20: *Eucarazzia elegans* (Ferr.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view).

Eucarazzia elegans (Ferrari)

1872. *Rhopalosiphum elegans* Ferrari, *Ann. Mus. Civ. Stor. Nat. Genova*, III, p. 217.
1921. *Eucarazzia picta* Del Guercia, *Redia*, XIV, p. 135.
1926. *Rhopalosiphoninus salviae* Hall, Tech. and Sc. Serv., Min. Agric. Egypt., 68, pp. 43-44.
1930. *Anuraphis (Clavisiphon) elegans* Del Guercia, *Redia*, XIX, p. 194.
1950. *Rhopalosiphoninus chicotei* Gomez-Menor Ortego, *Eos* (extra volume), pp. 110-113.
1953. *Eucarazzia elegans* Hille Ris Lambers, *Temm.*, IX, p. 32.

First recorded in Egypt by HALL (1926), on *Salvia* sp., as a new species under the name of *Rhopalosiphoninus salviae*.

Antennal formula 6-3-(4-5) ; unguis about four times as long as the base ; number of rhinaria on 3rd and 4th antennal segments is 21 and 7, respectively ; 5th segment without secondary rhinaria. Apical rostral segment with 6 secondary hairs.

MATERIAL : One specimen on *Lavandula stœchas,* 10 Jan. 1935, Rabat, Morocco (B.M., 1934, 624).

Genus DACTYNOTUS Rafinesque

1758-1855. *Aphis* partim, Auctores diversi.
1818. *Dactynotus* Rafinesque, *Amer. Mon. Mag. and Critic Review*, III, pp. 15-18.
1855-1901. *Siphonophora* Koch partim, Auctores diversi.
1887-1901. *Nectarophora* Oestlund partim, Auctores diversi.
1901-1933. *Macrosiphum* Passerini partim, Auctores diversi.
1911. *Macrosiphoniella* Del Guercio, *Redia*, VII, p. 332.
1914. *Uroleucon* Mordvilke, Faune Russie, Ins. Hémipt., I (1), p. 64.
1914. *Uromelan* Mordvilke, Faune Russie, Ins. Hémipt., I (1), p. 64.
1914. *Eurythaphis* Mordvilke, Faune Russie, Ins. Hémipt., Ibid., I (1), p. 66.
1919. *Megalosiphum* Mordvilke, Fauna Russie, Ins. Hémipt., Ibid., I (2), p. 357.
1922. *Tritogenaphis* Oestlund, 19th Rapt. State, Ent. Minnesota, p. 142.
1932. *Belochilum* Börner, in Sorauer, Handb. d. Pflanzenker (Edit. 4), V (2), p. 630.

Head : Frontal tubercles usually well developed, diverging with inner side little rounded and smooth. Antennae 6-segmented and may be nearly equal or much longer to the length of the body ; 3rd segment with 6-numerous rhinaria ; antennal hairs nearly equal in length to the 3rd segment, with spear-shaped or little knobbed apex. Rostrum extends to third coxa or further with rather long and narrow apical segment but not with concave margins (as it is in *Macrosiphoniella* Del Guercio).

Thorax : Normal. Legs long and spinose ; tibiae yellow to black with black apices ; basal half of femorae always pale ; first tarsal segment in all legs usually with 5 hairs. Fore wing with M twice branched ; hind wing with M and Cu present.

Abdomen : Terga never homogenously sclerotised and without transverse bars over the width of the abdomen as in the case in *Macrosiphoniella.* Small lateral tubercles may be present on the fifth terga. They appear as holes in the lateral sclerites. Dorsal setae with scleroites which may be well-developed, reduced, or pale and invisible. They may also get fused and bear 2-4 setae. The same is often the case with lateral setae. Post-siphuncular sclerites are nearly always present ; antesiphuncular sclerite absent or present. Siphunculi long, nearly cylindrical, usually hardly sclerotised, black and with a distinct reticulated "polygonal" area which extends distally over 1/9-2/5 their total length, but flange not well developed. Cauda sword-shaped, elongated, rarely constricted at basal third, sclerotised yellow (Sub-genus *Dactynotus* Raf. s.s.) or black (Sub-genus *Uromelan* Mordw.), with 7-30 irregularly arranged hairs.

It is represented in Egypt by three species only, namely *Dactynotus sonchi* (L.), *Dactynotus (Uromelan) solidaginis* (Fab.) and *Dactynotus (Uromelan) jacae* (L.).

KEY TO THE SUB-GENERA

1. Cauda yellow. Siphunculi black, or yellowish brown with dark apices and bases. Abdominal setae with reduced or invisible scleroites at their bases ... ... *Dactynotus* Raf. s.s.

—   Cauda black, sclerotised. Siphunculi black. Abdominal setae with distinct scleroites at their bases ... ... *Uromelan* Mordw.

KEY TO THE SPECIES

1(2) Cauda yellow. 3rd antennal segment about 1.4 times as long as 4th ... ... *D. sonchi* L.)

—   Cauda black. 3rd antennal segment about 1.5 to 1.6 times as long as 4th 2

2(1) 3rd antennal segment usually shorter than unguis. Reticulated area of siphunculi about 1/6 its total length. Genital plate with few hairs ... ... *U. solidaginis* (Fab.).

—   3rd antennal segment usually longer than unguis. Reticulated area of siphunculi about 1/5 its total length. Genital plate with numerous hairs ... ... *U. jacae* (L.)

Dactynotus sonchi (Linnaeus)

1767. *Aphis sonchi* L., Systema Nature (ed. XII), p. 735.
1872. *Siphonophora sonchi* Ferrari, *Ann. Mus. Civ. Stor. Nat.*, Genova, III, p. 215.
1901. *Macrosiphum sonchi* Schouteden, *Ann. Soc. Ent. Belg.*, XXX, p. 117.
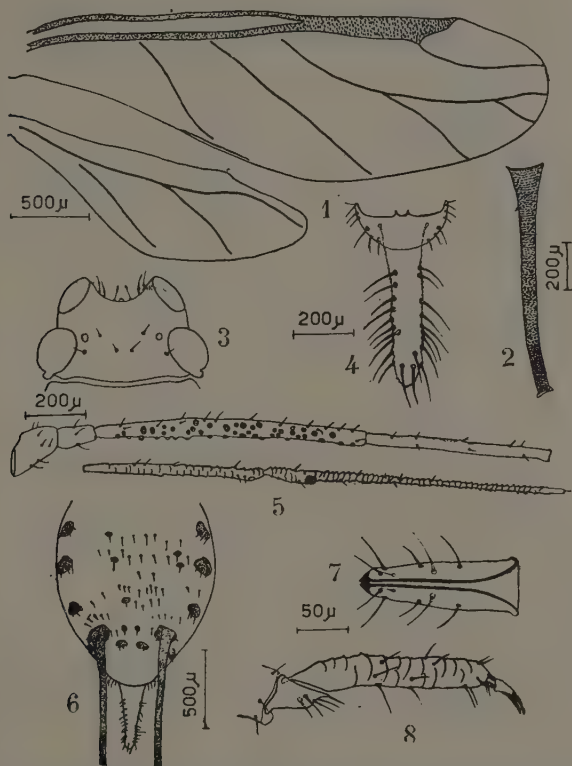1932. *Dactynotus sonchi* Börner, in Sorauer, Handb. d. Pflanz. (ed. IV, V (2),
      p. 630.

Fig. 21: *Dactynotus sonchi* (L.). — 1. Fore and hind wings; 2. Siphunculus;
3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna;
6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind
tarsus.

WILLCOCKS (1922) collected specimens of this species from thistles
(*Carduus* sp.). HALL (1926) found it on *Sonchus oleracea* and *Cheno-
podium* sp.

General colour brown on both sides.

Head : Brown. Eyes brown also. Antennae with black scape and
pedicel ; flagella are also black with whitish bases ; antennal formula

6-3-4-5 ; unguis 5.9 times as long as the basal part ; number of rhinaria
on 3rd antennal segment 46 ranging 38-55, scattered over the whole
length of the segment ; fourth antennal segment with no rhinaria.
Proboscis brown with a black tip ; apical rostral segment with 6 se-
condary hairs.

Thorax : Brown. Legs with light black and translucent femorae
except at distal end where it is dark black ; tibiae are also light black
and translucent except at tips or both distal and proximal ends where
they are dark black ; tarsi black, with 5 hairs on 1st segment. Wing
membranous with white or light black veins.

Abdomen : Brown. Lateral sclerites present ; abdominal scleroites
absent or rudimentary. Siphunculi black, cylindrical and inclined at
an angle of about 135° to the plane of the abdomen ; polygonal area at
the apex about 1/6 the whole length. Cauda white to yellow, trans-
lucent, without marked constriction at the base, bearing more than
20 long setae.

MATERIAL : 10 specimens on *Sonchus oleracae,* Dec. 1957, Koubba
Palace (authors' coll.).

Dactynotus (Uromelan) solidaginis (Fabricius)

1794. *Aphis solidaginis* Fabr., *Entomologica Systematica,* IV, p. 20.
1855. *Siphonophora solidaginis* Koch, Die Pflanzenläuse Aphiden, p. 197.
1901. *Macrosiphum solidaginis* Schouteden, *Ann. Soc. Ent. Belg.,* XXXVIII,
    p. 116.
1929. *Megalosiphum solidaginis* Mordw., Food-Plant Catalogue, p. 82.
1939. *Dactynotus (Uromelan) solidaginis,* Hille Ris Lambers, *Temminckia,* III,
    p. 62.

First recorded in Egypt by WILLCOCKS (1922) on *Carthamus* tinc-
torius (Safflower).

Hairs on body, rather thick and long, placed on distinct scleroites.
Frontal tubercles well developed, diverging. Antennal formula 6-3-4-5 ;
3rd segment with rhinaria, ranging 52-56, over its whole length. Apical
rostral segment with 8 secondary hairs. First tarsal with 5 hairs.
Siphunculi long, apical polygonal reticulation about 1/6 of its whole
length. Antesiphuncular sclerite absent ; postsiphuncular sclerite
distinct.

MATERIAL : 2 specimens (slide no. 1952, 23) on *Solidago virgaurea,*
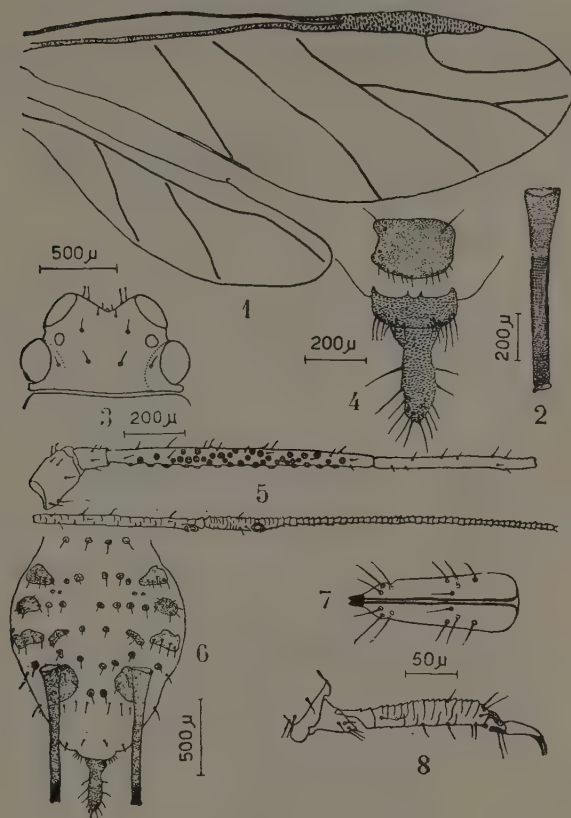24 June 1946 (DONCASTER coll., B.M.).

FIG. 22: *Dactynotus (Uromelan) solidaginis* (Fabr.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Dactynotus (Uromelan) jaceae (L.), sensu stricto.

1746. *Aphis centaureae* Linnaeus, Fauna Suecia (ed. I), p. 218.
1758. *Aphis jaceae* Linnaeus, Systema Naturae (ed. X), I, p. 452.
1855. *Siphonophora jaceae* Koch, Die Pflanzenläuse Aphiden, p. 162.
1901. *Macrosiphum jaceae* Schouteden, *Ann. Soc. Ent. Belg.*, XXXV, p. 116.
1929. *Megalosiphum jaceae* Mordw., Food-Plant Catalogue, pp. 81-82.
1931. *Dactynotus jaceae* Hille Ris Lambers, *Mem. Mus. Stor. Nat. Venezia Tridentina*, Trento, I, p. 42.
1939a. *Dactynotus (Uromelan) jaceae,* Hille Ris Lambers, *Temminckia,* III, p. 51.

First recorded in Egypt by HALL (1926) on *Centaurae cyanus* and *Carthamus* sp.

Hairs on body, rather long, placed on distinct scleroites. Frontal tubercles well developed, diverging. Antennal formula 6-3-4-5 ; 3rd segment with 60-62 rhinaria on its whole length. Apical rostral seg-
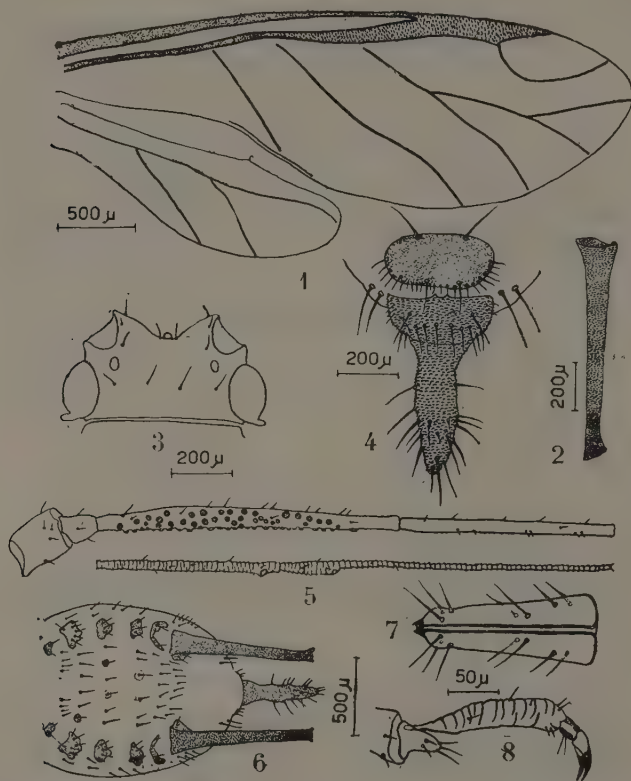

FIG. 23: *Dactynotus (Uromelan) jacae* (L.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; E. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

ment with 8 secondary hairs. First hind tarsal segment with 5 hairs. Siphunculi straight slightly decreasing in diameter towards apex ; apical reticulation about 1/5 of its whole length. Antesiphuncular sclerite little developed ; postsiphuncular sclerite distinct.

MATERIAL : One specimen on *Centaura nigra*, 24 June 1952, Cambridge-Bourn (slide No. 4409 B, B.M.).

Genus MACROSIPHUM Passerini

(Type : *Aphis rosae* L.)

HILLE RIS LAMBERS (1939a) classified this genus to the following three Sub-Genera :

1. Sub-Genus *Macrosiphum* Pass. s. s.

(Type : *Aphis rosae* L.)

1758-1855. *Aphis* Linnaeus, partim, Auctores diversi.
1855. *Siphonophora* Koch, partim, Auctores diversi.
1860. *Macrosiphum* Pass., *Jiorn. Jardini*, ann. 3, p. 27, note.
1887. *Nectarophora* Oestlund, Auctores diversi americani.
1901-1938. *Macrosiphum* Pass., partim, Auctores diversi.
1927. *Illenia* Soliman, partim, *Univ. Cal. Publ. Ent.*, IV, pp. 89-158.
1932. *Amphorophora* Börner, partim, in Corauer, Handb. d. Pflanzenkr. (ed. IV), V (2), p. 626.

2. Sub-Genus *Sitobion* Mordwilko

(Type : *Aphis avenae* Fab.)

1758-1855. *Aphis Linnaeus*, partim, Auctores diversi.
1855. *Siphonophora* Koch, partim, Auctores diversi.
1860. *Macrosiphum* Passerini, *Jiorn. Jardini*, ann. 3, p. 27, note.
1877. *Nectarophora* Oestlund, Auctores diversi americani.
1914. *Sitobion* Mordw., Faune Russie, Ins. Hémipt., I (2), p. 65.
1919. *Anameson* Mordw., partim, Faune Russie, Ins. Hémipt., I (2), p. 336.
1923. *Aphidella* Theobald, *Ent. Mon. Mag.* (3), IX, p. 105.
1927. *Aphidiella* Theobald, Aph. Great Britain, II, p. 219.
1929. *Sitobion* Nevsky, partim, Tli Srednei Asii, p. 75.
1939. *Amphorophora* Börner, in Sorauer, Handb. d. Pflanzenkr. (ed. IV), V (2), p. 626.

3. Sub-Genus *Illinoia* Wilson

1855. *Siphonophora* Koch, partim, Auctores diversi.
1860. *Macrosiphum* Pass., *Jiorn. Jardini*, ann. 3, p. 27, note.
1877. *Nectarophora* Oestlund, Auctores diversi americani.
1910. *Illinois* Wilson, *Ann. Ent. Soc. America*, III, p. 318.
1926. *Macrosiphum* Theobald, partim, Aph. Great Britain, I, p. 55.

This Sub-Genus is not represented in Egypt.

Genus MACROSIPHUM Pass.

Body ellipsoid, comparatively large, shiny without waxy secretions.

Head : Frontal tubercles well developed or small with a pronounced median ocellus. Antennae usually longer than body with rhinaria which are absent in the apterous forms of *Illinoia*. Rostrum different in length.

Thorax : Normal. Legs long, pale except at joints where the colour darkens ; first tarsal segments with 3 hairs.

Abdomen : May be weakly sclerotised as in *Macrosiphum* s. s. which is characterised by the presence of lateral sclerites and some isolated sclerites on the last segments. It may be strongly sclerotised as in *Sitobion* which is characterised by the presence of intersegmental dark pleural areas. In the former case the alate and the apterous forms, the ornamentation is similar, while in the latter the ornamentation of both forms is slightly differed. Siphunculi black or coloured, usually cylindrical, 1/6-3/8 length of the body, with enlarged bases, sometimes narrower in the middle and with distinct flange. The apical reticulated "polygonal" area is almost remarkably narrow and constitute from 1/10 to 3/10 the total length. Cauda long, slender and never darkly sclerotised, sometimes constricted near base, with 7-20 hairs not arranged in pairs.

The most characteristic features of this genus as given by EASTOP (1953) are :

1. The characteristic close position of the stigmas on abdominal segments 1 and 2.

2. The absence of the lateral abdominal tubercles from segments 1 and 7, and their presence on segments 2 to 5.

3. The reticulated apices of the siphunculi.

KEY TO THE SUB-GENERA

1. Apterous forms with sclerotised terga ; frontal tubercles depressed ; median tubercles prominent ... ... *Sitobion* Mordwilko

— Apterous forms without sclerotised terga ; frontal tubercles well developed ; median tubercles small ... *Macrosiphum* Passerini s.s.

Each of these two Sub-Genera is represented in Egypt by one species only and thus the separation of the two species can be carried out either by the above key (apterae) or by the following (alatae) :

1. Rhinaria on 3rd antennal segment more than 20 ; 6th antennal segment as long as siphunculus ... ... *M. rosae* (L.)

— Rhinaria on 3rd antennal segment less than 15 ; 6th antennal segment more than twice as long as siphunculus *S. avenae* (F.)

Macrosiphum rosae (L.), sensu stricto

1758. *Aphis rosae* Linnaeus, Systema Naturae (ed. X), I, p. 452.
1763. *Aphis scabiosae* Scopoli, Entomologia Carniolica, p. 138.
1801. *Aphis dipasci* Paula von Schrank, Fr., Fauna Boica, II, p. 117.

1855. *Siphonophora rosae* Koch, Die Pflanzenläuse Aphiden, p. 178.
1860. *Macrosiphum rosae* Passerini, *Jiorn. Jardini*, ann. 3, p. 27.
1871. *Siphonophora rosaecola* Passerini, *Bull. Soc. Ent. Ital.*, III, p. 134.
1876. *Siphonophora scabiosae* Buckton, Monc. Brit. Aphides, I, pp. 112-113.
1887. *Nectarophora rosae* Oestlund, Geol. Nat. Hist. Survey Minnesota, Bull. 4, p. 181.
1903. *Nectarophora valeriance* Clarke, *Canad. Ent.*, XXXV, p. 253.
1906. *Macrosiphum scabiosae* Sehouteden, *Mém. Soc. Entom. Belg.*, XX, p. 240.
1915. *Macrosiphum fragariae* Theobald, *Entomologist*, XXXVIII, p. 182.
1926. *Macrosiphum centranthi* Theobald, Aph. Great Britain, I, pp. 104-106.
1927. *Macrosiphum tanaceticolum* Zirnits, *Zeitschr. Wiss. Ins. Biol.*, XXII, p. 206.
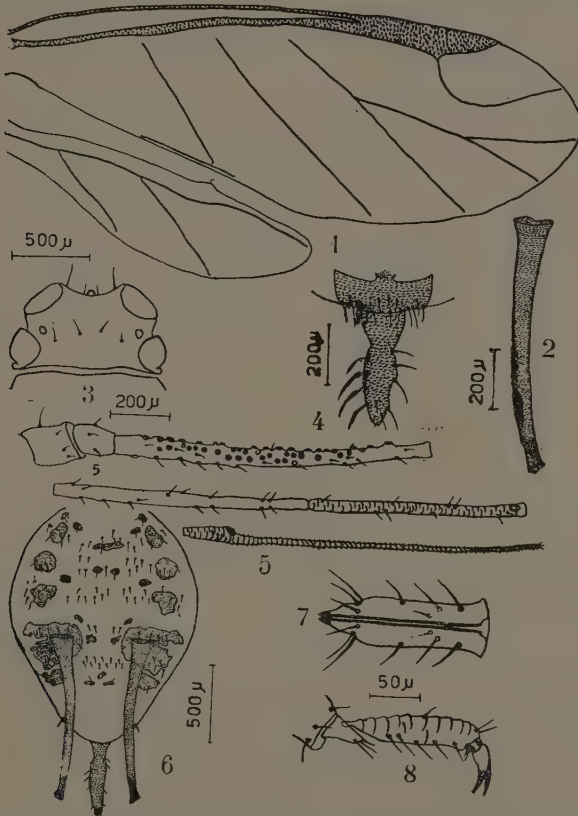

FIG. 24: *Macrosiphum rosae* (L.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Recorded in Egypt by WILLCOCKS (1922) and HALL (1926). General colour green, with pear-shaped body.

Head : Light brown from both sides with dark brown eyes. Antennae black all over ; antennal formula 6-3-4-5 ; average number of rhinaria on 3rd antennal segment 39 ranging 30-47. Proboscis light brown with a dark tip ; apical rostral segment with 8 secondary hairs.

Thorax : Acrotergum greenish ; prothorax light brown dorsally and green ventrally with a green dorsal intersegmental membrane between it and the mesothorax ; mesothorax light brown from both sides nearly similar to prothorax in colour. Legs with femora greenish at their bases (2/3), the rest being dark brown ; tibiae light brown except at two extremities where the colour darkens ; tarsi dark brown also with hind tarsus bearing 3 hairs on first segment.

Abdomen : Green from both sides except the ventral surface of the last segment which may be brownish, with distinct lateral sclerites on segments 1 to 4. Ante- and post-siphuncular sclerites present. Siphunculi long, cylindrical and dark coloured ; diverging backwards and are raised upwards in their normal position, they are wide at their bases and are a little constricted just before their tips ; flange distinct ; reticulation comprises the portion beyond the constriction (5/33 of the total length), the rest being imbricated.

MATERIAL : Ten specimens on roses, March 1957, Koubba Palace (authors' coll.).

Macrosiphum (Sitobion) avenae (Fabricius)

1775. *Aphis avenae* Fabricius, Systema Entomologiae, p. 736.
1798. *Aphis granaria* Kirby, *Trans. Linn. Soc. London,* IV, p. 238.
1815. *Aphis hordei* Kyber, Germar's Mag. Entom., I, p. 15.
1843. *Aphis cerealis* Kaltenbach, Mono. d. Pflanzenläuse, p. 16.
1848. *Aphis lyoepsidis* Walker, *Zoologist,* VI, p. 2219.
1855. *Siphonophora cerealis* Koch, Die Pflanzenläuse Aphiden, p. 186.
1879. *Siphonophora avenae* Thomas, Eight Rept. State Ent. Illinois, p. 51.
1887. *Nectarophora granaria* Oestlund, Geol. Nat. Hist. Survey Minnesota, Bull. 4, p. 82.
1901. *Macrosiphum granarium* Schouteden, *Ann Soc. Ent. Belg.,* XXXV, p. 114.
1904. *Siphonophora granaria* Pergande, U.S. Dept. Agri. Div., Bull. 44, pp. 5-23.
1913. *Macrosiphum cerealis* Mokrzecki, Rept. on inj. Ins., etc. of Taurida, Simferopol., pp. 1-23.
1918. *Macrosiphum alii* Jackson, *Scottish Naturalist,* p. 83.
1921. *Sitobion avenae* Mordwilko, *Bull. Petrograd Div. Stat. Protect.,* III (3).
1921. *Macrosiphum miscanthi* Takahashi, Aph. Formosa, I, p. 8.
1921. *Macrosiphum alopecuri* Takahashi, Aph. Formosa, I, p. 9.
1927. *Aphidiella secretocauda* Theobald, Aph. Great Britain, II.
1927. *Illinoia granaria* Soliman, *Univ. Cal. Publ. Ent.* IV, p. 131.
1928. *Macrosiphoniella triglochiniella* Theobald, Aph. Great Britain, III, p. 325.
1939a. *Macrosiphum (Sitobion) avenae* Hille Ris Lambers, *Temminckia,* IV, p. 108.

Commonly known as grain-aphid. First recorded by WILLCOCKS (1922) on the blades and green ears of wheat and barley, later by HALL (1926) on grasses, sedges, *Cynodon dactylon* and *Andropogon sorghum.*
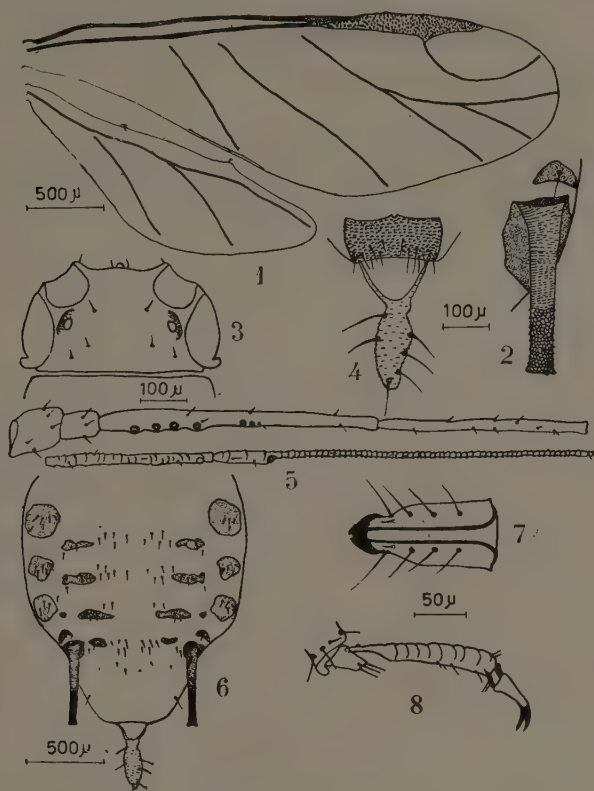
FIG. 25: *Macrosiphum (Sitobion) avenae* (Fabr.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

The present writers collected most of their specimens from wheat. An interesting record was its presence on *Nictiana* sp. grown in the Faculty's farm at Koubba Palace.

General colour of the body green.

Antennal formula 6-3-4-5 ; number of rhinaria on 3rd antennal segment 9 ranging 4-10 arranged in one line and confined to basal part when few in number. Apical rostrol segment with 4 secondary hairs. Hind tarsus with 3 hairs on the first segment. Abdomen with small dark intersegmental sclerites present on abdominal segments 2-5, each usually with a small tubercle, post-siphuncular sclerite distinct.

MATERIAL : 5 specimens on *Nicotiana* sp., April 1956, Koubba Palace, and 5 specimens on wheat, April 1956, Koubba Palace (authors' coll.).

Genus MACROSIPHONIELLA Del Guercio

(Type : *Aphis atrum* Ferr.)

1758-1855. *Aphis*, partim, Auctores diversi.
1855-1901. *Siphonophora*, partim, Auctores diversi.
1901-1933. *Macrosiphum*, partim, Auctores diversi.
1911. *Macrosiphoniella* Del Guercio, partim, *Redia*, VII, p. 331-333.
1913. *Macrosiphum* V. d. Goot, *Tijdschr. v. Sntom.*, LV, p. 145.
1913. *Macrosiphoniella* Del Guercio, *Redia,* IX, p. 188.
1914. *Dielcyamura* Mordwilko, Faune Russie, Ins. Hémipt., I, p. 65.
1922. *Tritogenathis* Oestlund, partim. 19th Rep. Sta. Entom. Minnesota, p. 142.

HOTTES and FRISON (1931) considered this genus as a sub-genus to the genus *Macrosiphum* while BAKER (1920) and HILLE RIS LAMBERS (1938) considered it as a distinct genus.

Head : Frontal tubercles often little developed and diverging. Sinus frontalis therefore slightly to strongly concave. Antennae 6-segmented, usually longer than body, armed with sub-circular prominent rhinaria ; 4th segment equal or very little longer than 5th and 3rd longer than both ; the sixth is the longest. Apical rostral segment stiletto-shaped, often with concave margins.

Thorax : Normal. Legs long, usually srongly sclerotised ; first tarsal segment with 3 hairs.

Fore wing with M twice branched, hind with both M and Cu present.

Abdomen : Tergum not uniformly sclerotised ; transverse bars absent ; a distinct semilunar ante-siphuncular sclerite is nearly always present, it is rarely absent or very indistinct ; post-siphuncular sclerite always absent. Siphunculi truncated coniform, short and thick ; sometimes long and slender in which case they are little swollen near the base and thinnest in the middle ; distal 2/5 to 3/4 part of siphunculi covered with a polygonal structure ; without a distinct flange. Cauda long usually acute and more or less constricted at basal 1/3 part. Caudal hairs irregularly arranged, from 6 to numerous.

Represented in Egypt by 4 species only, namely, *M. sanborni* (Gillette), *M. parthinii* n. sp., *M. absinthii* (L.) and *M. artemisiae* (B.d.F.).

KEY TO THE SPECIES

1(2) Fourth antennal segment with rhinaria ... ... *sanborni* Gillette
—   Fourth antennal segment without rhinaria 2
2(1) Siphunculi more than as twice as long as the cauda ; reticulated
     part of siphunculi from 1/5 to 1/4 their whole length ... ...
     ... ... *parthinii* n. sp.

— Siphunculi· equal or little longer than cauda ; reticulated part of siphunculi about half the whole length 3

3(2) Third antennal segment with a high number of rhinaria (more than 100) ... ... *abthinii* L.

— Third antennal segment with a low number of rhinaria (less than 30) ... ... *artemisae* B. d. F.

Macrosiphoniella sanborni (Gillette)

1904. *Macrosiphum chrysanthemi* Sanborn, *Kans. Univ. Scient. Bull.*, III, pp. 73-74.

1908. *Macrosiphum sanborni* Gillette, *Canad. Ent.*, XL, p. 65.

1910. *Siphonophora chrysanthemicolens* Williams, Univ. Nebraska Studies, X (2), pp. 75-76.

1911. *Macrosiphoniella chrysanthemi* Del Guercio, *Redia*, III, pp. 332-333.

1913. *Macrosiphoniella chrysanthemi* var. *brevicauda* Del Guercio, *Redia*, IX, p. 117.

1914. *Macrosiphoniella bedfordi* Theobald, *Bull. Ent. Research*, IV, pp. 318-319.

1917. *Macrosiphoniella sanborni* V. d. Goot, Contrib. Faune Ind. Néerl., I (3), pp. 36-39.

1918. *Macrosiphum nishigaharae* Essig and Kuwana, *Proc. Californ. Acad. Sciences,* (4), VIII, pp. 50-51.

Commonly known as *Chrysanthemum* aphid. First recorded in Egypt by WILLCOCKS (1922) on *Chrysanthemum* sp. and gave it the aynonym *Macrosiphoniella chrysanthemi*. HALL (1926) found it throughout the whole year except during January and February. The present writers could find it during January and February on the shoots and the cuttings used for propagation, a fact which shows that the species reproduce parthenogenetically on *Chrysanthemum* the whole year round without reproduction of sexual forms.

General colour of body shining chestnut.

Head : Eyes brown to black. Antennae with dark brown scape and pedicel and yellowish basal part of flagellum ; rest of flagellum brown ; antennal formula 6-4-3-5 ; unguis 4.6 times as long as the basal part ; mean number of rhinaria on 3rd segment 28 ranging 22-37, while on the 4th segment it is 6 ranging 3-9 ; rhinaria occurring on the third and fourth segments different in size and degree of protrusion from surface. Apical rostral segment accuminate, and nearly equal in length to the 3nd segment of hind tarsus.

Thorax : Legs long with dark brown coxae ; femur yellowish with brown basal and distal parts ; tarsi black with first segment bearing 3 hairs.

Abdomen : Brown, with black conical siphunculi ; reticulation of siphunculi about 5/8 the whole length. Cauda cylindrical and constricted near the base ; little longer than the siphunculus. Anal plate heavy brown.
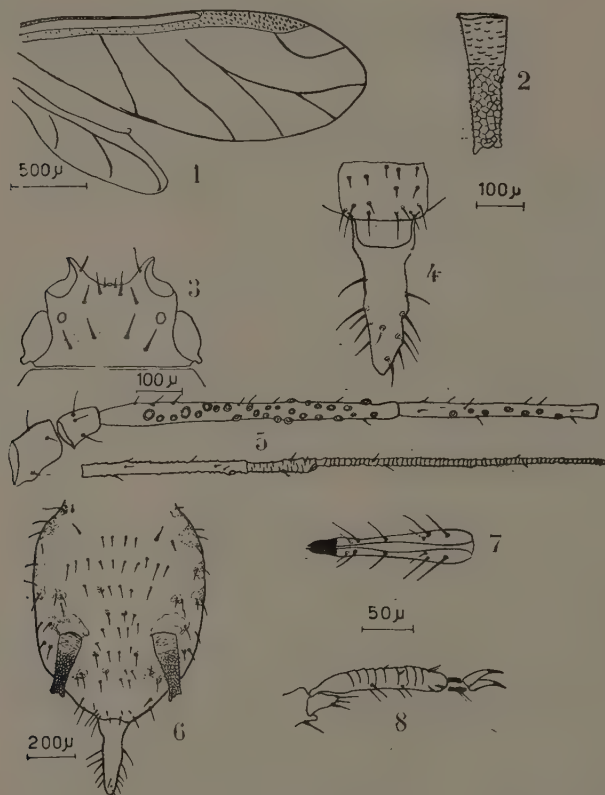

FIG. 26: *Macrosiphoniella sanborni* (Gillette). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral seqment (dorsal view); 8. Hind tarsus.

Macrosiphoniella parthinii, n. sp.

The writers collected this plant-louse from *Chrysanthemum parthinifolium* in May. It was usually found on the terminal parts of the flowering stems and on the upper leaves.

General colour of the body green.

Head : Greenish white dorsally and yellowish green ventrally. Eyes red. Antennae with yellowish green scape and pedicel ; flagellum light black and semi-translucent ; antennal formula 6-3-4-5 ;
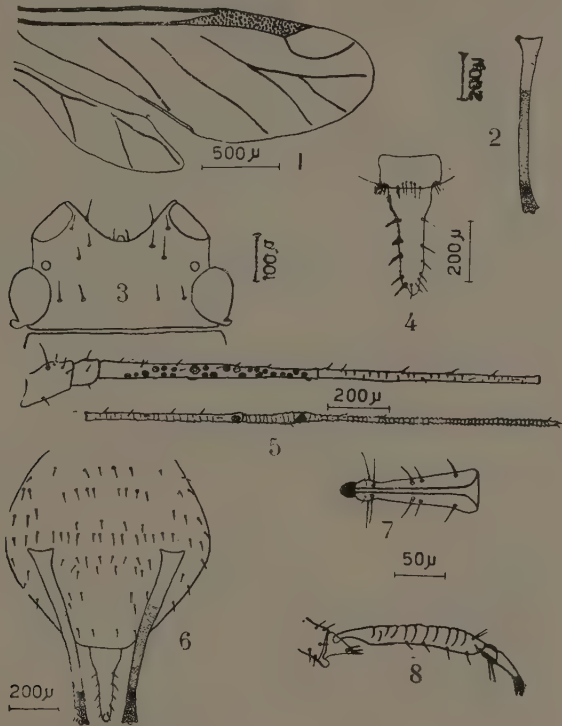

FIG. 27: *Macrosiphoniella parthinii* n. sp. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view) ; 4. Cauda and anal plate (ventral view) ; 5. Antenna; 6. Abdomen (dorsal view) ; 7. Apical rostral seqment (dorsal view) ; 8. Hind tarsus.

unguis about four times as long as the basal part ; average number of rhinaria on 3rd antennal segment 37 ranging 34-44. Tip of proboscis black and acute while the rest is green to yellow ; apiacl rostral segment with 6 secondary hairs.

Thorax : Prothorax green while meso- and metathorax light green to light black. Legs with light green coxae while the rest is light black and heavy black at the tibio-femoral junction, at the distal part of the tibia and at the tarsus ; first hind tarsal segment with 3 hairs.

Abdomen : Light green and pear-shaped with a longitudinal mid-dorsal green line. Two lateral green lines are also found. Six horizontal rows of small spots are dorsally arranged on the six abdominal segments. A number of spots on each of the rows is as follows : 8 on first ; 10 on second, third and fourth ; 6 on fifth (between bases of siphunculi) ; and 4 on sixth.

It is worth mentioning that some laboratory reared-specimens had those spots fading.

Cauda light green. Siphunculi long, cylindrical, diverging and terminally dilated. They lie horizontally in the same plane of the body when at rest. Their colour is black with greenish basal part (1/5). Anal plate green.

The present writers have sent a sample of this species to Dr. EASTOP of the British Museum who kindly identified it as *Macrosiphoniella chamomillae-tapuskae* group. The writers are still inclined to consider it as a new species, since it actually has a mixture of characters of the two species of the above group besides having certain characters of its own.

The only character which is similar in both *parthinii* and the two species of this group is the shape of siphunculi which are long and slender, yet it differs from both *chamomillae* and *tapuskae* in the following :

(1) Colour of body of living specimens of this species is green, decorated with six dorsal horizontal rows of small white spots on the abdomen while it is also green in *tapuskae* but with a dark green dorsal band between and around the bases of siphunculi. The colour of *chamomillae* is not given by any author.

(2) Antennal formula, although it is similar in *parthinii* to the two species of this group (6-3-4-5), yet the ratio of the lengths of these segments is significantly different in *parthinii* from the other two.

Other characters present in *parthinii* may be similar to one of the two species while different from the other, thus :

(1) Secondary rhinaria completely absent from the 4th antennal segment as in *tapuskae* (HOTTES and FRISON, 1931) while are present in *chamomillae* (STROYAN, 1950).

(2) Number of rhinaria on the 3rd antennal segment (about 37) is nearly similar to that in *tapuskae* (36-38) while is evidently different from that in *chamomillae* (55-60).

(3) The unguis on the other hand is similar to that of *chamomillae* (4 times as long as the base) while different from that of *tapuskae* (6 times).

(4) Then number of hairs on the cauda is also similar to that of *chamomillae* (12) but different from that of *tapuskae* (8).

These criteria are clearly sufficient to emphasise the view of considering this species as a new species to which the name *M. parthinii* is suggested.

MATERIAL : 10 specimens on *Chrysanthemum parthinifolium*, May 1957, Koubba Palace (authors' coll.).

Macrosiphoniella absinthii (Linnaeus)

1758. *Aphis absinthii* L., Systema Naturae (ed. X), p. 452.
1855. *Siphonophora absinthii* Koch, Die Pflunzenläuse Aphiden, p. 198.
1906. *Macrosiphum absinthii* Schouteden, Cat. Aph. Belg., *Mém. Soc. Ent. Belg.*, XII, p. 237.
1913. *Macrosiphoniella lineata* Del Guercio, *Redia*, IX, p. 116.
1913. *Macrosiphcniella fasciata* Del Guercio, *Redia*, IX, p. 189.
1913. *Macrosiphoniella absinthii* Del Guercio, *Redia*, IX, p. 117.

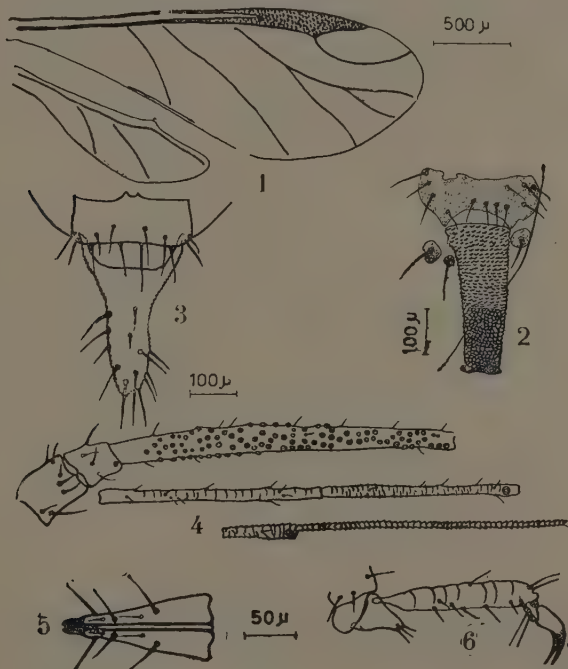HALL (1926) collected this species on *Artemisia* sp. in May and June.

FIG. 28: *Macrosiphoniella absinthii* (L.). — 1. Fore and hind wings; 2. Siphunculus; 3. Cauda and anal plate (ventral view); 4. Antenna; 5. Apical rostral segment (dorsal view); 6. Hind tarsus.

Antennal formula 3-6-4-5 ; unguis about 1.7 times as long as the basal part ; rhinarial number on 3rd antennal segment 137. Apical rostral segment acuminate, bearing 4 secondary hairs. Hind tarsus bears 3 hairs on the first segment. Sclerotic plates only present on 2nd, 3rd and 4th abdominal segment. Siphunculi cylindrical ; reticulation about half the whole length. Large antesiphuncular sclerites present.

MATERIAL : One specimen on *Artemisia absinthium,* 10 June 1952, Cambridge (slide No. 4046, British Museum).

Macrosiphoniella artemisiae (B. d. F.)

1841. *Aphis artemisiae* Boyer de Fonscolombe, *Ann. Soc. Ent. France,* X, p. 162.
1848. *Aphis absinthii* Walker, *Ann. Mag. Nat. Hist.* (2), II, p. 202.
1855. *Siphonophora tanacetaria* Koch, Planzenläuse Aphiden, pp. 187–188.
1872. *Siphonophora artemisiae* Ferrari, *Ann. Mus. Civ. Stor. Nat. Genova,* III, p. 212.
1913. *Macrosiphum artemisiae* Theobald, *Journ. Econ. Biol.,* VIII, p. 71.
1913. *Macrosiphoniella artemisiae* Del Guercio, *Redia,* IX, p. 117.
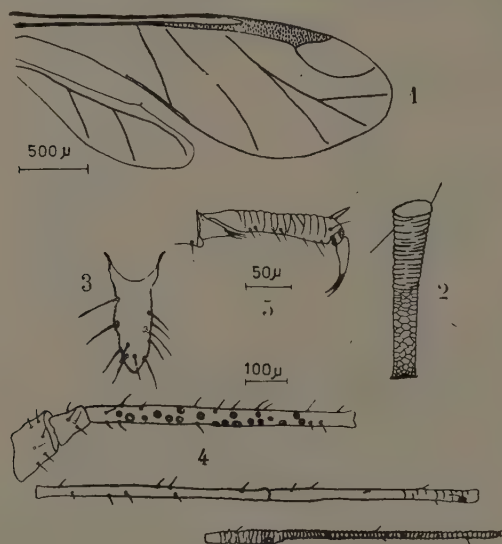1928. *Neoacaudus inflatus* Theobald, *Entomologist,* LXI, p. 9.

FIG. 29: *Macrosiphoniella artemisiae* (B. d. F.). — 1. Fore and hind wings; 2. Siphunculus; 3. Cauda and anal plate (ventral view); 4. Antenna; 5. Hind tarsus.

First recorded in Egypt by HALL (1926) on *Artemisia* sp. and *Achillea* sp.

Antennal formula 4-6-3-5 ; unguis about 2.8 as long as the base ; number of rhinaria on 3rd. segment 19, 3rd. segment bears no rhinaria. Reticulationof siphunculi about half the whole length. First hind tarsal segment with 3 hairs.

MATERIAL : One specimen on *Artemisia herba alba*, 5 May 1938, Wadi Bahouma — El Salloum ,coll. Min. Agric.).

Genus MYZUS Passerini

(Type : *Aphis cerasi* Fab.)

1860. *Myzus Passerini*, Gli Afidi, p. 27.
1860. *Rhopalosiphum* Passerini, Gli Afidi, p. 27.
1913. *Myzoides* Van der Goot, *Tijd. voor Ent.*, LVI, p. 84.
1913. *Ovatus* Van der Goot, *Oijd. voor Ent.*, LVI, p. 84.
1914. *Aulacorthum* Mordwilko, Faune Russ. Aphidoidea, p. 58.
1916. *Neomyzus* Van der Goot, Zur Kennt. der Blattläuse Java's, p. 50.
1918. *Myzopis* Matsumira, *Trans. Sapporo Nat. Hist. Soc.*, VII (1), p. 19.

BAKER (1920) gave a precise résumé about the synonomy of this genus and returned back to the original name *"Myzus"* of PASSERINI 1860.

Frontal tubercles distinct, projecting inwards and strongly gibbous. Antennae 6-segmented, with a gibbous first segment similar to the frontal tubercles. Wing venation normal. Abdomen usually with a well-developed dorsal black patch over segments 3 to 5. Siphunculi rather long and subcylindrical or clavate. Cauda somewhat short and conical, sometimes with a medium constriction, bearing only 4 to 6 hairs.

Represented in Egypt by two species, namely *M. persicae* Sulz. and *M. plantagineus* (Pass.). HALL (1926) gave a third species *"amygdalinus* Fars." specimens of which were not available anywhere.

KEY TO THE SPECIES

1. Rhinaria on 4th antennal segment absent. Siphunculi distinctly swollen at tip ... ... *persicae* Sulz.
— Rhinaria on 4th antennal segment present. Siphunculi not swollen at tip ... ... *plantagineus* Pass.

Myzus persicae (Sulzer)

1776. *Aphis persicae* Sulzer, Abgekürzte Geschichte der Insecten nach dem Linneischen System. Winterthur, H. Steiner u. Co., II (2), p. 105.

1915. *Rhopalosiphum lactucellum* Theobald, *Bull. Ent. Res.*, VI, p. 103.

1915. *Myzus persicae* Sulzer, after Hall (1926). Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68, pp. 1-62.
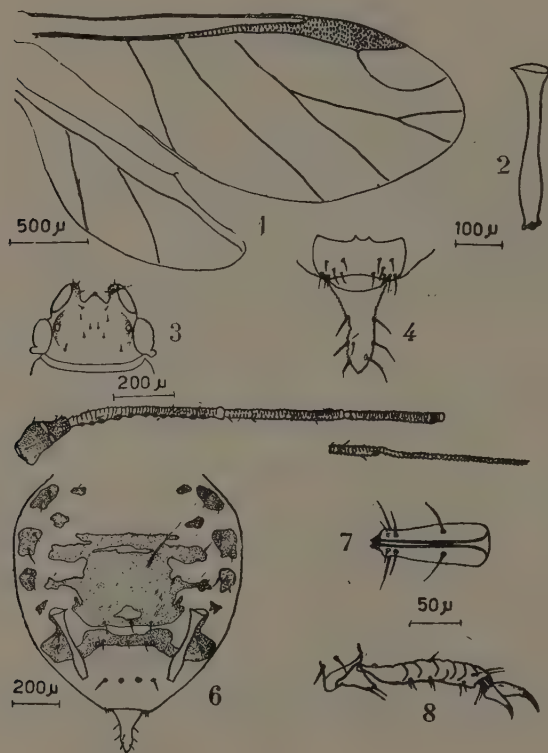

FIG. 30: *Myzus persicae* (Sulzer). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

An economically important species, commonly known as green peach aphid and widely distributed, first described from Egypt by THEOBALD (1915) under the name of *Rhopalosiphum lactocellum*, which was considered later by HALL (1926) as a synonym to *Myzus persicae*.

The following hosts are added by the writers to HALL's list : *Eruca sativa (Cruciferae); Ammi majus (Umbelliferae); Carduus dipsacus*

*(Compositae); Petunia hybrida (Solanaceae); Lantana camara (Ver-
benaceas); Malva rotundifolia (Malvaceae); Dolichos lablab (Legumi-
nosae); Cucurbita sp. (Cucurbitaceae); Moricandia nitens (Cruciferae).*

Antennal formula 6-3-4-5 ; unguis more than 3 times as long as
the basal part ; number of rhinaria on 3rd antennal segment ranges
from 9 to 14. Apical rostral segment with one pair of hairs on the
basal 1/2 to 3/5, other than 3 apical (STROYAN, 1957). First hind tar-
sal segment with 2 hairs.

Males were also recorded for the first time in Egypt by means of
a light trap. This may denote the occurrence of sexual reproduction,
a fact which was not known before in Egypt. Specimens were kindly
identified by Dr. EASTOP of the British Museum. They differed mainly
from the alate viviparous females in the following :

1. Fourth antennal segment is clearly shorter in spite of the
antennal formula being the same in both (6-3-4-5).

2. Siphunculi and cauda shorter, the latter with a high number
of setae (9) than in the female (6).

3. Rhinaria are not restricted to the 3rd antennal segment as in
the female, but are present in higher numbers on the 3rd, 4th, and 5th
segments, their numbers ranging from 27 to 47, 13 to 28 and 6 to 23,
respectively.

4. Dorsal sclerotised patch of abdomen ornamented with non-
sclerotised areas.

MALE GENITALIA (after SNODGRASS, 1935) : Claspers or "harpagones",
a pair of short conical slender lobes about 74μ in length each, ranging
from 66 to 88μ. Aedeagus, tubular with a broad base, about 121μ in
length, ranging from 99 to 154μ.

MATERIAL : 10 specimens of alate viviparous females, on *Eruca
sativa*, March 1956, Koubba Palace, and 10 specimens of alate males
caught on the light trap, March 1958, Koubba Palace (authors' coll.).

Myzus plantagineus Passerini

1860. *Myzus plantagineus* Pass., Gli Afidi, p. 35.

First recorded in Egypt by HALL (1926), on *Plantago major,* who
stated that the living alate forms resemble those of *M. persicae* Sulz.

Antennal formula 6-3-4-5 ; unguis about 5.5 times as long as basal
part ; rhinaria on the 3rd, 4th and 5th antennal segments are 59, 24
and 8, respectively. Apical rostral segment with 4 secondary hairs.
First hind tarsal segment with 2 hairs. Lateral abdominal sclerites

present with tubercle within each of the 1st and 2nd sclerite ; a nearly rectangular spinal sclerite present ; 7th and 8th abdominal tergites dis-
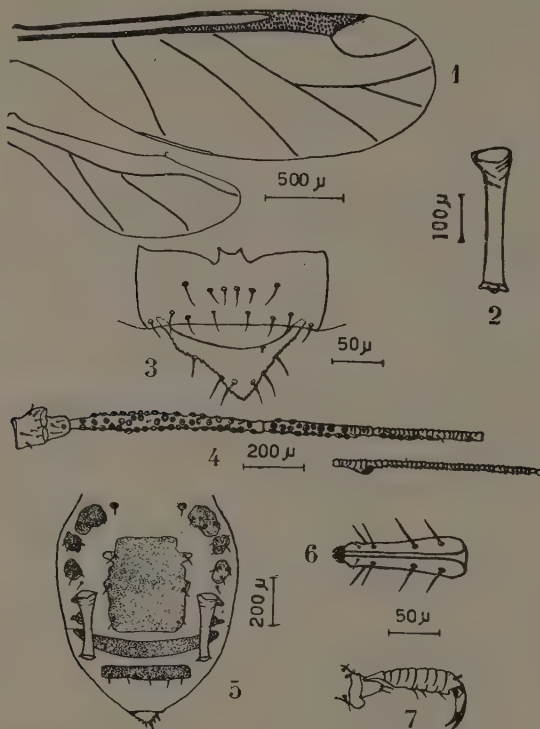

FIG. 31: *Myzus plantagineus* Pass. — 1. Fore and hind wings; 2. Siphunculus; 3. Cauda and anal plate (ventral view) ; 4. Antenna; 5. Abdomen (dorsal view) ; 6. Apical rostral segment (dorsal view) ; 7. Hind tarsus.

tinct with a pair of dorsal tubercles on the latter ; postsiphuncular sclerite present. Siphunculi cylindrical. Cauda triangular more or less acuminate and very short.

MATERIAL : One specimen on *Plantago major*, 19 March 1924, Giza (slide no. 212, coll. Min. Agric.).

Genus RHODOBIUM Hille Ris Lambers

(Type : *Macrosiphum rosaefolium* Theobald)

1947. *Rhodobium* Hille Ris Lambers, *Temminckia*, VII, p. 300.

A genus newly erected by HILLE RIS LAMBERS (1947b). He states that it is mainly characterised by the absence of the reticulated area

from the siphunculi, a character which distinguishes it from the genus *Macrosiphum* Pass. in spite of the shape of the cauda and abdominal sclerites in the alate forms being nearly similar in the two genera. It can also be distinguished from *Acyrthosiphon* by the rough frontal tubercles which are small and protracted inwards causing the frontal farrow to be wide.

Represented in Egypt by one species only, namely *Rhodbium porosum* (Sanderson).

Rhodobium porosum (Sanderson)

1900. *Myzus porosus* Sanderson. after Eastop (1957), Colonial Office, Hull Printers Limited, London.
1915. *Macrosiphum rosaefolium* Theobald, *Bull. Ent. Research,* VI, p. 109.
1917. *Aulacorthum viride* Van der Goot, Contrib. Faune Ind. Néerland., I (3), p. 31.
1922. *Aulacorthum pseudorosaefolium* Blanchard, *Physis,* Buenos Ayres, V, pp. 199-201.
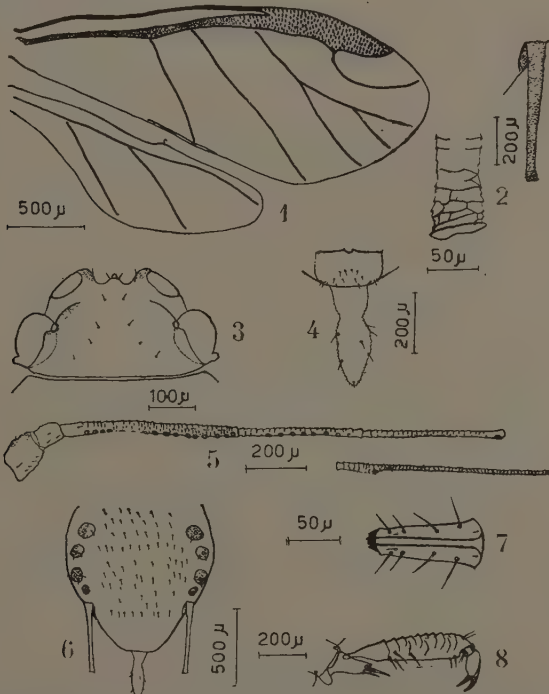

FIG. 32: *Rhodobium porosum* (Sanderson). — 1. Fore and hind wings. 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

1931. *Acyrthosiphon rosaefoliae* Takahashi, Aph. Formosa, VI, p. 64.
1936. *Acyrthosiphon rosaefolii* Shen Tseng and Chia-Chu Tao, *Ent. and Phy-topath.*, Hangchow, V, p. 146.
1947b. *Rhodobium rosaefolium* Hille Ris Lambers, *Temminckia*, VII, p. 301.
1947b. *Rhodobium porosum*, after Eastop, 1958, Colonial Office, Hull Printers, London.

First recorded from Egypt by THEOBALD (1915), on roses, under the name of *Macrosiphum rosaefolium*, n. sp. (WILLCOCKS's collection).

Antennal formula 6-3-4-5 ; unguis about 4 times as long as basal part ; number of rhinaria on 3rd and 4th antennal segments 17 ranging 14-21, and 7 ranging 2-8 ; 5th segment without secondary rhinaria. Apical rostral segment with 4 hairs. First hind tarsal segment with 3 hairs. Lateral abdominal sclerites distinct within a small tubercle, each ; postsiphuncular sclerite present. Siphunculi cylindrical and long. Cauda with a median constriction.

MATERIAL : 10 specimens on roses, March 1957, Koubba Palace (authors' coll.).

Genus CHAETOSIPHON Mordwilko

(Type : *Capitophorus chaetosiphon* Nevsky)

1914. *Chaetosiphon* Mordwilko, Faune Russie, Ins. Hemipt., I (1), p. 71.

Body of apterous forms and nymphs covered with thick capitate hairs carried on strongly sclerotised parts of the integument, single or in groups. Such hairs are normal in alate forms.

Head : Frontal tubercles moderately developed, somewhat angular with 2-3 hairs at inner apex and 0-1 thinner hair ventrally ; median tubercles small but conspicuous. Antennae ; first segment with inner apex angular or rounded ; third one with numerous often tuberculate rhinaria, sometimes also on the fourth. Rostrum rather long, reaching the hind coxae, with a rather slender and acute apical segment, bearing 3-13 hairs other than the 3 apical hairs.

Thorax : Legs rather short ; first tarsal segment of all legs with 5 hairs. Wings with normal venation, with dark brown veins.

Abdomen : Membraneous with dark transverse spino-pleural bars which are fused to a sclerotic patch on some of the segments ; lateral sclerites, well developed, but rather pale with a dark centre, and often with a lateral tubercle on segments 2-5.

Meso-, metathorax and most of the anterior abdominal segments are almost characterised by carrying duplicated hairs placed in a trapezoid (a term used by HILLE RIS LAMBERS denoting a protuberance).

Siphunculi, variable, sometimes very thin, more or less cylindrical with larger base, usually curved inwards, imbricated with well developed flange.

HILLE RIS LAMBERS (1953) recognised *Pentatrichopus* Börner and *Chaetosiphon* Mordw. as two sub-genera for this genus, which differ only by the absence of capitate hairs from the siphunculi of the former. *Chaetosiphon*, however, is not represented for the time being in Egypt.

Sub-Genus PENTATRICHOPUS Börner

(Type : *Aphis tetrarhoda* Walker)

1855-1887. *Siphonophora* Koch, partim, Auctores diversi.
1887. *Nectarophora Oestlund,* partim, Minnesota Geol. Nat. Hist. Survey, Bull. 4, p. 83.
1886-1922. *Myzus Passerini,* partim, Auctores diversi.
1915-1950. *Capitophorus* Van der Goot, partim, Auctores diversi.
1930. *Pentatrichopus* Börner, *Arch. f. Klass. u. Phylog. Entom.,* I, p. 140.

Represented in Egypt by one species only, namely *P. tetrarhodus* (Walker).

Pentatrichopus tetrarhodus (Walker)

1849. *Aphis tetrarhoda* Walker, *Ann. Mag. Nat. Hist.* (2), III, p. 42.
1855. *Siphonophora rosarum* Koch, Die Pflanzenläuse Aphiden, p. 180.
1911. *Myzus rosarum* Williams, Univ. Nebraska Studies, X, pp. 67-68.
1915. *Capitophorus tetrarhodus* V. d. Goot, Beitr. z. Kenntnis d. Holl. Blattläuse, pp. 128-131.
1915. *Myzus neorosarum* Theobald, *Bull. Ent. Res.,* VI, p. 112.
1922. *Myzus tetrarhoda* Blanchard, *Physis* (Buenos Ayres), V, p. 209.
1926. *Capitophorus neorosarum* Theobald, Aph. Great Britain, I, pp. 248-249.
1930. *Pentatrichopus tetrarhodus* Börner, *Arch. f. Klass. u. Phylog.,* Ent., V (1), p. 140.
1953. *Capitophorus (Pentatrichopus) tetrarhodus* Hille Ris Lambers, *Temminckia,* IX, p. 78.

First recorded in Egypt by WILLCOCKS (1922) on roses. HALL (1926) considered *Capitophorus neorosarum* (in THEOBALD's collection), as an allied species to *C. tetrarhodus*. They were considered later by HILLE RIS LAMBERS (1953) as synonyms.

Antennal formula 3-6-4-5 ; 3rd antennal segment, long, with rather large tuberculate rhinaria around the whole segment, and ranging from 58 to 76 ; unguis 3.4 times as long as the basal part. Apical rostral segment with 8 secondary hairs. First hind tarsal segment with
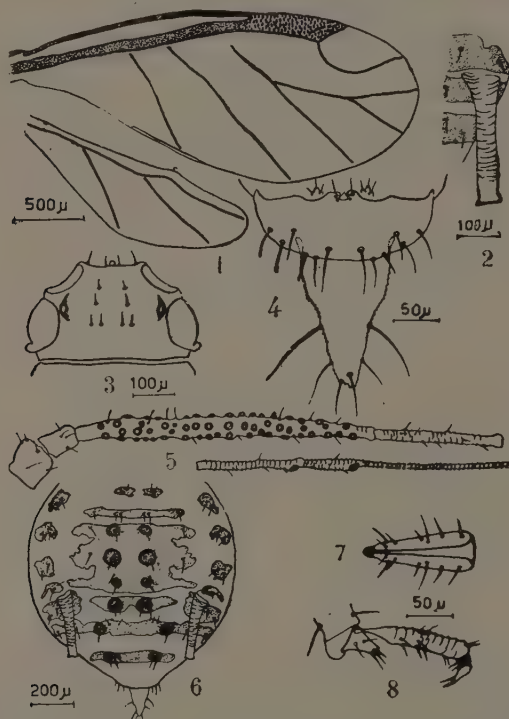

FIG. 33: *Pentatrichopus tetrarhodus* (Walker). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

5 hairs. Abdomen with a dark transverse bar on each of 2nd, 6th, 7th and 8th segment ; those transverse sclerotic bars on 3rd to 5th segments are fused in a one patch ; lateral sclerites small, each with a small tubercle and two hairs ; spinal hairs of abdominal segments, duplicated and carried on low protuberance. Siphunculi sclerotised, ante- and postsiphuncular sclerites present, the latter being larger.

MATERIAL : 4 specimens on *Rosa* sp., 23 May 1950, Reading Barks (slide No. 1431, British Museum).

Genus CAPITOPHORUS Van der Goot

(Type : *Aphis carduina* Walker)

1854. *Rhopalosiphum* Koch, partim, Die Pflanzenläuse Aphiden, p. 28.
1860-1914. *Myzus* Passerini, partim, Gli Afidi, p. 34.
1913. *Capitophorus* V. d. Goot, *Tijdschr. v. Entomologie*, LVI, p. 84.
1913-1947. *Capitophorus* V. d. Goot, partim, Auctores diversi.

The dorsal hairs of the alate forms are nearly all normal with blunt tips and placed on small normal bases while in apterous forms they are thick, with globular or even depressed ellipsoid apices, and placed on strong tubercle-like bases either single or in groups.

Head : Frontal tubercles variably developed. Antennae 6-segmented ; 1st segment normal in structure though enlarged at inner apex ; 3rd and 4th segments with many rhinaria, a little so on 5th. Those rhinaria on 3rd segment are more or less transversely oval, all around the segment, while those on more distal segments occur often along one side and are more circular. Hairs on the basal antennal segments usually capitate, on the flagellum usually thin with normal blunt apices. Rostrum varying in length ; apical segment rather long and very acute.

Thorax : Normal. Hairs not capitate. First tarsal segments with 3 hairs on each. Wing venation normal.

Abdomen : Usually blackish pigmented, rectangular spinal sclerite present, extending from posterior margin of 3rd tergum to posterior margin of the 5th or even the middle of the 6th tergum, with almost straight sides. Siphunculi, about 1/4 length of body, usually dark or with their bases slightly paler, more straight than in apterous forms, smooth or faintly imbricated ; cylindrical or swollen on distal half. Cauda usually dark, acute with 5-11 hairs.

Represented in Egypt by two species only, namely *C. hippophaes* (Walker) and *C. elaegni* (Del Guercio).

KEY TO SPECIES

1. Siphunculi distinctly clavate on distal half ... *hippophaes* Walker
— Siphunculi cylindrical or slightly tapering from base to apex ...
... ... *elaeagni* Del Guercio

Capitophorus hippophaes (Walker)

1852. *Aphis hippophaes* Walker, List Homopt. Ins. Brit. Mus., IV, p. 302.
1863. *Phorodon galeopsidis* Pass., Aph. Italicae, p. 19.

1908. *Myzus elaegni* Davis, *Ann. Ent. Soc. America,* V, p. 251.
1915. *Capitophorus hippophaes* V. d. Goot, Beitr. z. Kenntnis d. Holl. Blattläuse, pp. 122-125.
1926. *Capitophorus gillettei* Theobald, Aph. Great Britain, I, pp. 238-241.

The writers recorded this species in Egypt for the first time amongst specimens collected from the light trap, which were kindly identified by Dr. EASTOP of the British Museum.
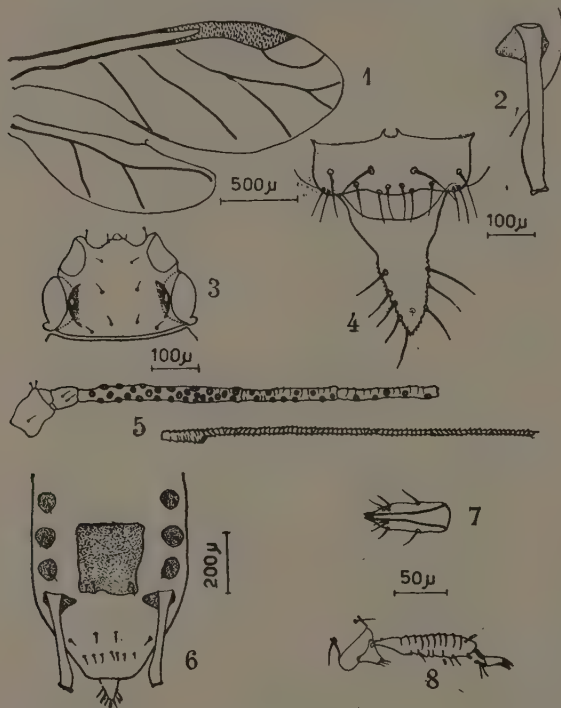
FIG. 34: *Capitophorus hippophaes* (Walker). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Antennal formula 6-3-4-5 ; unguis about 7.5 times as long as the basal part ; rhinaria on the 3rd, 4th and 5th antennal segments ranged from 28 to 41, 10 to 20 and 6 to 12, respectively. Apical rostral segment with one pair of secondary hairs. First hind tarsal segment with 3 hairs. Abdomen with a large nearly quadrangular spinopleural sclerite ; lateral sclerites small. Siphunculi swollen distally. Post-siphuncular sclerite obvious. Cauda acute, slender and triangular.

MATERIAL : 10 specimns caught on the light trap, March 1958, Koubba Palace (authors' coll.).

Capitophorus elaeagni (Del Guercio)

1894. *Myzus elaeagni* Del Guercio, *Naturalista Siciliano*, XIII (10), pp. 189-199.
1908. *Myzus bragii* Gillette, *Canadian Entomologist*, XL, p. 17.
1912. *Phorodon carduinum* Davidson, *Journ. Econ. Ent.*, V, p. 409.
1913. *Capitophorus elaeagni* V. d. Goot, *Tijdschr. v. Entomologie*, LV, p. 84.
1915. *Capitophorus bragii* V. d. Goot, *Beitr. z. Kenntnis d. Holl. Blattläuse*, pp. 110-122.
1918. *Myzus carthusianorum* Haviland, *Entomologist*, LI, p. 658.
1922. *Capitophorus cynariella* Theobald, *Bull. Soc. Roy. Ent. Egypte*, VII, pp. 39-42.
1926. *Capitophorus carthusianorum* Theobald, Aph., Great Britain, I, p. 256.
1928. *Capitophorus cirsii* Nevsky, *Entt Mitt.*, LVII, p. 195.

THEOBALD (1922) described a species collected by WILLCOCKS attacking *Cynara scolymus* in Egypt and named it *Capitophorus cynariella* n. sp. HALL (1926), examining THEOBALD's species, concluded that it has to be referred to *C. bragii* Gillette (a synonym to *elaegni*).
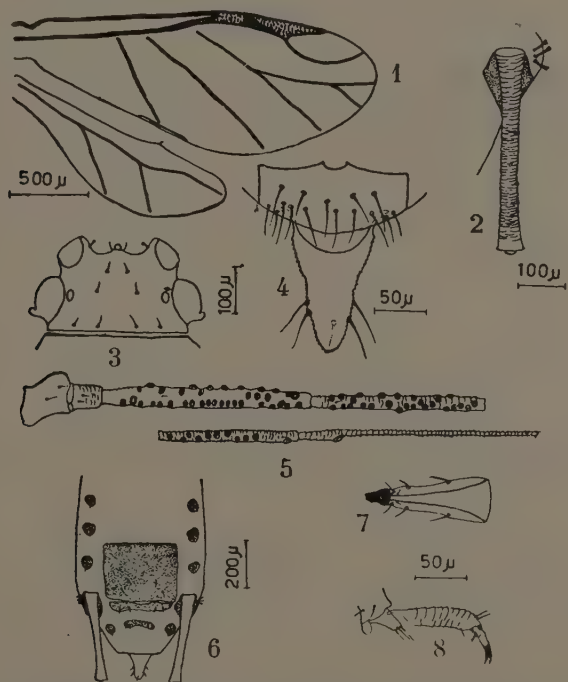

FIG. 35: *Capitophorus elaeagni* (del Guercio). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

The writers collected specimens from artichoke which are typically similar to HALL's specimens.

Antennal formula 6-3-4-5 ; unguis about 7.5 times as long as the basal part ; number of rhinaria on 3rd, 4th and 5th antennal segments ranges from 38-57, 22 to 42 and 7 to 19, respectively. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 3 hairs. Abdomen with nearly rectangular spino-pleural sclerite ; lateral sclerites small. Hairs rather thin, normal, except those on the 6th abdominal tergum, are with fan-shape apices. Siphunculi cylindrical, with distinct postsiphuncular sclerite. Cauda short, acute and triangular.

MATERIAL : 10 specimens on *Cynara scolymus*, May 1957, Koubba Palace (authors' coll.).

Genus PLEOTRICHOPHORUS Börner

(Type : *Aphis glandulosa* Kltb.)

1846. *Aphis* Linnaeus, Kaltenbach, partim, *Stettin. Ent. Zeit.*, VII, p. 170.
1912. *Myzus* Pass., partim, V. d. Goot, *Tijdschr. v. Ent.*, LV, p. 68.
1926. *Capitophorus* V. d. Goot, partim, Theobald, Aph. Great Britain, I, p. 296.
1930. *Pleotrichophorus* Börner, *Arch. f. Klass. u. Phylog. Entom.*, I, p. 138.
1934-1946. *Macrosiphum* Pass., partim, Auctores diversi americani.

BÖRNER (1930) considered *Pleotrichophorus* as a sub-genus of *Capitophorus* V. d. Good owing to the number of hairs on the pronotum being higher than 8 (the characteristic number in *Capitophorus*). HILLE RIS LAMBERS (1953) considered it as a distinct genus after adding the following characters :

(1) Presence of many capitate hairs in both apterous and alate forms.

(2) Absence of a central sclerite on the abdomen.

(3) Apical rostral segment stiletto-shaped.

Represented in Egypt by one species only, namely *P. chrysanthemi*.

Pleotrichophorus chrysanthemi (Theobald)

1920. *Capitophorus chrysanthemi* Theo., *Bull. Ent. Res.*, IX, pp. 69-70.
1953. *Pleotrichophorus chrysanthemi* Hille Ris Lambers, *Temminckia*, IX, p. 119.

First recorded in Egypt by HALL (1926) on *Chrysanthemum*.

General colour green with a waxy appearance, with a clear longitudinal mid-dorsal green line extending from the median ocellus to the end of the body.

Head : Light green in colour except for the dark mid-dorsal line. Eyes brown to black with a dark area surrounding the median ocellus. Antennae with green scape and pedicel, and pale black flagellum ;
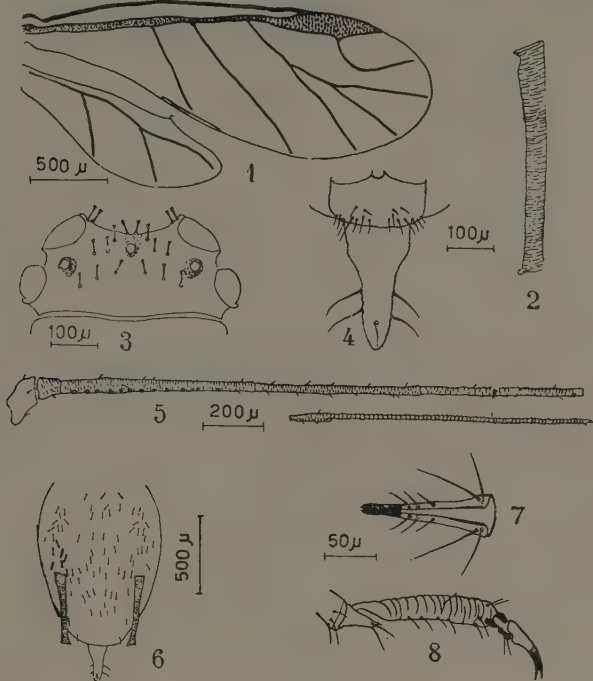

FIG. 36: *Pleotrichophorus chrysanthemi* (Theo.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view) ; 4. Cauda and anal plate (ventral view) ; 5. Antenna; 6. Abdomen (dorsal view) ; 7. Apical rostral segment (dorsal view) ; 8. Hind tarsus.

antennal formula 6-3-4-5 ; unguis nearly more than six times as long as the basal part ; number of rhinaria on 3rd segment ranges from 11 to 16, located in a line extending along the whole segment. Proboscis green with a black tip ; apical rostral segment with 4 secondary hairs.

Thorax : Blackish green. Legs translucent light green, with black colour at tips of tibiae and tarsi ; first tarsal segment of hind leg with 2 hairs. Wing venation normal ; wings membranous with heavily black veins.

Abdomen : Light green with the dark mid-dorsal line. Dorsal setae fan shaped, while the ventral spinal. Siphunculi light green, translucent, cylindrical and converging. Cauda and anal plate light green.

MATERIAL : 10 specimens on *Chrysanthemum*, Dec. 1956. Koubba Palace (authors' coll.).

Genus COLORADOA Wilson

(Type : *Aphis rufomaculata* ·Wilson)

1910. *Colorados* Wilson, *Ann. Ent. Soc. Am.,* III, p. 323.

Frontal tubercles absent, the frons convex. Antennae 5- or 6-segmented ; secondary rhinaria on 3rd, 4th and often also 5th ; unguis from about equal in length to 3 times as long as basal part ; antennal hairs short, less than 10 μ long, and inconspicuous. Apical rostral segment stiletto-shaped, all the hairs rather short. Wing venation normal but the veins dark and slightly bordered. First tarsal segments with 3 : 3 : 2 hairs. Abdomen without dorsal pigmentation except on tergites 6 to 8 which often bear dark bands ; 7th and 8th tergites sometimes with spinal tubercles. Siphunculi gently clavate. Cauda longer than broad and usually with 4-5 hairs.

Most American authors have not recognised this genus, but place the species in *Rhopalosiphum* Koch.

Represented in Egypt by one species only, namely *Coloradoa rufomaculata* (Wilson).

Coloradoa rufomaculata (Wilson)

1908. *Aphis rufomaculata* Wilson, *Entomological News,* XIX (6), p. 261.
1908. *Stephensonia lahorensis* (Das), after Hall (1926), Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68, pp. 1-62.
1908. *Rhopalosiphum lahorensis* (Das), after Hall (1926), Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68, pp. 1-62.
1908. *Coloradoa rufomaculata* (Wilson), after Eastop (1958), Colonial Office, Hull Printers Limited, London.

First recorded in Egypt by WILLCOCKS (1922) under the name of *Stephensonia lahorensis* on *Chrysanthemum*. HALL (1926), transferred it to genus *Rhopalosiphum*.

General colour green.

Head : 'Light black dorsally· and green ventrally, with or red brownish eyes. Antennae with green scape and pedicel, and a black flagellum except at the base where it is whitish and translucent. Antennal formula 6-3-4-5 ; unguis nearly twice as long as basal part ;

number of rhinaria on third, fourth and fifth antennal segment ranges from 11 to 17, 4 to 10 and 1 to 5, respectively. Apical rostral segment with 4 secondary hairs.
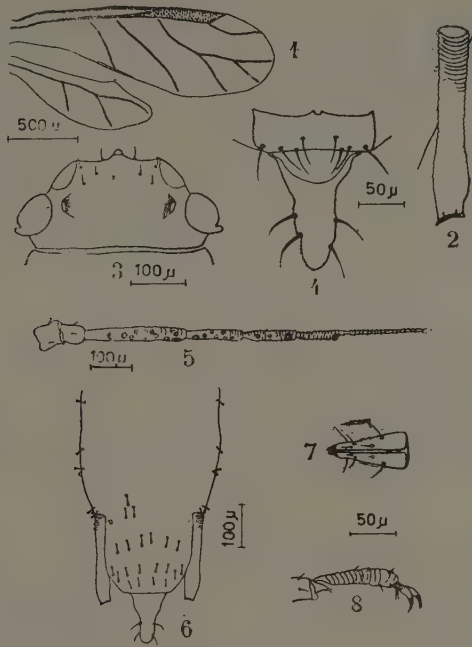

FIG. 37: *Coloradoa rufomaculata* (Wilson). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Thorax : Prothorax green, mesothorax black from both sides while metathorax black dorsally and green ventrally. Some specimens showed abnormal venation in the fore wing, the M being once branched in one side and twice branched on the other ; veins obvious and dark in colour. First hind tarsal segment with two hairs.

Abdomen : Green, clothed dorsally with capitate hairs while ventrally with spinal hairs and without dorsal pigmentation. Siphunculi cylindrical, horizontal in their position with a slightly swollen apex and inclined inwards at their black tips. Anal plate dark green.

MATERIAL : 10 specimens on *Chrysanthemum*, Dec. 1957, Koubba Palace (authors' coll.).

Genus ACYRTHOSIPHON Mordwilko

(Type : *Aphis pisi* Kalt.)

1841-1855. *Aphis* Linnaeus, partim, Auctores diversi.
1855-1901. *Siphonophora* Koch, partim, Auctores diversi.
1877-1911. *Nectarophora* Oestlund, partim, Auctores diversi americasi.
1901-1941. *Macrosiphum* Pass., partim, Auctores diversi.
1914. *Acyrthosiphon* Mordw., Faune Russie, Ins. Hémipt., I (1), p. 75.
1917. *Macchiatiella* Del Guercio, *Redia,* XII, p. 210.
1930. *Macchiatiella* Del Guercio, partim, *Redia,* XIX, p. 86.
1939. *Mirotarsus* Börner, *Arb. Phys. u Angew. Entom.,* VI, p. 83.

A genus erected by MORDWILKO in 1914, who placed under it some species previously related to the genera *Macrosiphum* and *Dactynotus* because they possessed certain similar characters which can be summarised as follows :

1.   Siphunculi non-reticulated.
2.   Frontal tubercles nearly smooth and diverging.
3.   Cauda without constriction.

He considered *Rphis pisi* Kalt. (= *Aphis pisum* Harris) as a type species and subdivided the genus to four sub-genera, namely : *Acyrthosiphon* Mordw. s. s., *Microlophium* Mordw., *Amphorophora* Buckton and *Metopolophium* Mordw.

Later HILLE RIS LAMBERS (1947) raised those sub-genera to the rank of genera and erected three other sub-genera for the gsnus *Acyrthosiphon* Mordw., namely *Liporrhinus* Börner, *Lactucobium* H. R. L. and *Acyrthosiphon* Mordw. s. s. to which the only species represented in Egypt, *Acyrthosiphon pisum* (Harris) is related.

Acyrthosiphon pisum (Harris)

1776. *Aphis pisum* Harris, Expcsit. English Insects, London, pp. 66-67.
1841. *Aphis onobrychis* B. d. F., *Ann. Soc. Ent. France,* X, p. 169.
1841. *Aphis lathyri* Mosley, *Gard. chronicle,* I (Oct. 16th), p. 684.
1843. *Aphis pisi* Kaltenbach, Mono. d. Fflanzenläuse, pp. 23-24.
1855. *Siphonophora spartii* Koch, Die Pflanzenläuse Aphiden, pp. 172-173.
1855. *Siphonophora ononis* Koch, Die Pflanzenläuse Aphiden, pp. 175-176.
1855. *Siphonophora pisi* Koch, Die Pflanzenläuse Aphiden, pp. 190-191.
1863. *Siphonophora ulmariae* Passerini, *Archiv. Zoologia,* II, p. 136.
1886. *Siphonophora corydalie* Oestlund, 14th Ann. Rept. Geol. Not. Hist. Survey Minnesota, p. 25.
1900. *Nectarophora pisi* Sanderson, Delware Coll. Agric. Expt. Stat., Bull. 49, pp. 14-24.
1900. *Nectarophora destructor* Johnson, *Canad. Entom.,* XXXII, pp. 56-60.
1901. *Nectarophora pisi* (Kalt.) var. *destructor* Sanderson, *Canad. Entom.,* XXXIII, p. 31.
1904. *Macrosiphum trifolii* Pergande, U.S. Dept. Agric., Bull. 44, p. 21.
1906. *Macrosiphum ononis* Schouteden, *Mém. Soc. Ent. Belg.,* XII, p. 239.
1909. *Macrosiphum pisi* Chittnden, U.S. Dept. Agric., Circ. 43 (ed. II).

1914. *Acyrthosiphon pisi pisi* Mordwilko, Faune Russie, Ins. Hémipt., I (1), pp. 83-136.

1914. *Acyrthosiphon pisi destructor* Mordwilko, Faune Russie, Ins. Hémipt., I (1), pp. 136-138.

1914. *Acyrthosiphon pisi ussuriensis* Mordwilko, Faune Russie, Ins. Hémipt., I (1), pp. 140-141.

1915. *Macrosiphum theobaldi* Davis, U.S. Dept. Agric., Bull. 276, p. 4.

1917. *Macrosiphum (Acyrthosiphon) genistae* Theobald, *Entomologist*, I, p. 80.

1917. *Macchiatiella trifolii* Guercio, *Redia*, XII, p. 210.

1919. *Nectarosiphon pisi destructor* Hulbert, Univ. Idaho Agric. Expt. Stat., Bull. 115.

1925. *Illinois pisi* Fluke, *Journ. Econ. Ent.*, XVIII, p. 612.

1929. *Acyrthosiphon pisi* Nevsky, Tli Srednei Asii, p. 86.

1930. *Anuraphis (Macchiatiella) trifolii* Guercio, *Redia*, XIX, p. 86.

1930. *Anuraphis (Macchiatella) promedicaginis* Del Guercio, *Redia*, XIX, p. 189.

1934. *Macrosiphon onobrychis* Behlen, *Nachrichtenblatt deutsehc Pflanzen-schutzdienst*, X0V, pp. 48-51.

1940. *Acyrthosiphon onobrychis* Knechtel and Manolache, *Ann. Instit. Recherches Agron. Roumanie*, XII, p. 12-16.

1947. *Acyrthosiphon pisum* Hille Ris Lambers, *Temminckia*, VII, pp. 247-254.

First recorded from Egypt on broad beans and sweet beans by THEOBALD (1915) under the name of *Macrosiphum* pisi (Kalt.) WILLCOCKS' collection). Later WILLCOCKS (1922) and HALL (1922), added *Trifolium alexandrinum, Vicia fabae, Lathyrus sativus, Phasoolus vulgaris, Genista* sp., *Mallilotus indicus, Pisum sativum, Robinia pseudoacacia* and *Spartum juncum* as new host plants.

General colour green.

Head : Green with brownish red eyes. Lateral ocelli surrounded with black area. Antennae 6-segmented with a green scape and pedicel and a pale black flagellum ; the black colour darkens at the joints between 3rd, 4th and 5th antennal segments and also at the base of the unguis ; antennal formula 6-3-4-5 ; unguis more than three times as long as basal part ; number of rhinaria on 3rd segment ranges from 12 to 25 arranged in an irregular line ; 4th segment without rhinaria. Proboscis green with a black tip ; apical rostral segment with 4 secondary hairs.

Thorax : Prothorax green while meso- and metathorax light brown. Legs with green coxae, green femora with 1/3 terminal part black, white tibiae with 1/5 terminal part black, and tarsi black ; first tarsal segment with 3 hairs. Wing venation normal.

Abdomen : Green and pear-shaped with very small faint lateral sclerites. Siphunculi pale black with a green basal part (about 1/4 its length), cylindrical and diverging. Cauda green with no obvious constriction near its base.

MATERIAL : 10 specimens on *Vicia fabae*, March 1957, Koubba Palace (authors' coll.).
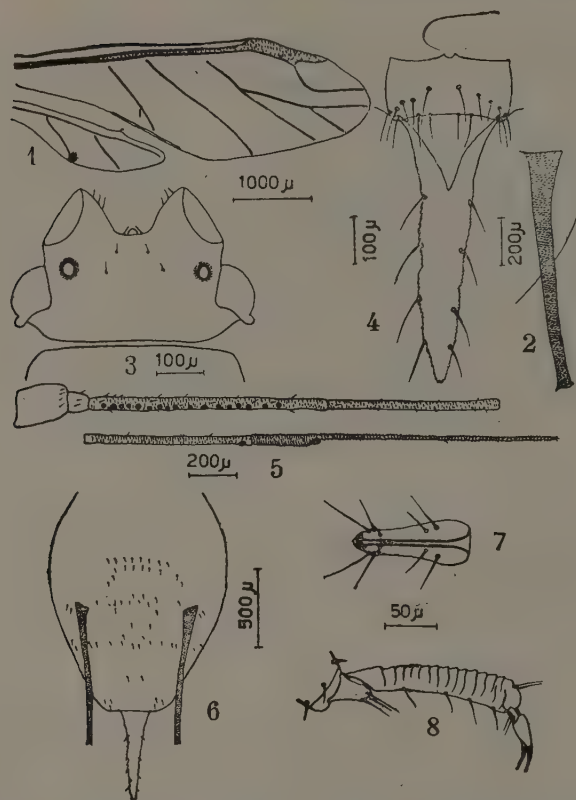
FIG. 38: *Acyrthosiphon pisum* (Harris). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Genus HYADAPHIS Kirkaldy

(Type : *Aphis xylostei* Schrk.)

1863. *Siphocoryne* Passerini, Aphididae Italicae, p. 8.
1904. *Hyadaphis* Kirkaldy, *The Entomologist*, XXXVII, p. 279.

Head with very small frontal tubercles or without. Compound eyes with a visible triommatidion. Antennae 6-segmented with secondary rhinaria on 3rd, 4th and sometimes 5th segments. Apical rostral segment shorter than 2nd hind tarsal segment bearing only 2 to 4 secondary hairs. First tarsal segments with 3 : 3 : 3 hairs. Wing venation normal. Mesosternal furca with a broad base.

Abdomen without dorsal pigmentation except on the lateral sclerites ; antesiphuncular sclerite bearing a conspicuous lateral tubercle,

a structure absent from or inconspicuous on the other segments. Dorsal abdominal hairs short and inconspicuous, those on the 8th targite only about 15 μ long. 8th tergite with 4 to 6 hairs. Siphunculi clavate, or short and gradually swollen, little if any longer than the cauda which bears 6 to 10 hairs.

Represented in Egypt by two species, namely *H. criandri* (Das) and *H. apii* Hall. Specimens of the latter species were inavailable to the present writers.

<div align="center">KEY TO SPECIES</div>

1. Antennal formula 6-3-4-5 ... ... *coriandri* Das.
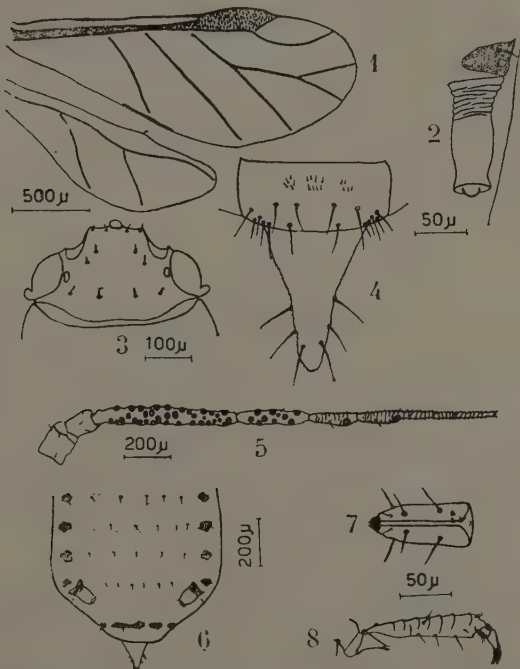— Antennal formula 3-6-4-5 ... ... *apii* Hall

FIG. 39: *Hyadaphis coriandri* (Das.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Hyadaphis coriandri (Das)

1918. *Hyadaphis coriandri* (Das), after Eastop (1958), Colonial Office, Hull
      Printers Limited, London.
1922. *Hyalopterus obscurus* Theobald, *Bull. Soc. Roy. Ent. Egypte*, XII, p. 39.
1929. *Hyalopterus carii* Theobald, after Eastop (1958), Colonial Office, Hull
      Printers Limited, London.
1932. *Hyalopterus peucedani* Hall, after Eastop (1958), Colonial Office, Hull
      Printers Limited, London.
1932. *Hyalopterus conica* Börner, after Eastop (1958), Colonial Office, Hull
      Printers Limited, London.

First recorded from Egypt by THEOBALD (1922) on Fennel (*Foeniculum vulgaris*) under the name *Hyalopterus obscurus* n. sp. (WILLCOCKS' collection). HALL (1926) collected it on *Anethum* sp., *Daucus carota*, *Coriandrum sativum*, *Andropogon* sp., and *Pithyranthus tortuosus*.

Antennal formula 6-3-4-5 ; unguis about 2.2 times as long as the basal part ; number of rhinaria on 3rd, 4th antennal segments 36 ranging 29-42 and 8 ranging 5-13, respectively ; 5th antennal segment without secondary rhinaria. Apical rostral segment bearing 2 secondary hairs. First hind tarsal segment with 3 hairs. Siphunculi usually somewhat clavate and shorter than the cauda which bears 6 or 7 hairs.

MATERIAL : 10 specimens on Fennel, April 1957, Koubba Palace (authors' coll.).

Hyadaphis apii (Hall)

1926. *Hyadaphis apii* Hall, Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68,
      pp. 1-62.

Described from Egypt by HALL (1926) from samples found on *Apium graveolens*.

The writers could not collect this species. Specimens in the Ministry's collection were missing. Following notes are according to HALL (1926).

Antennal formula 3-6-4-5 ; unguis about 3 times as long as the basal part ; number of rhinaria on 3rd, 4th antennal segments ranging 40-46 and 6-8, respectively ; 5th antennal segment without secondary rhinaria.

EASTOP (1958) stated that this species is probably a synonym to *Hyadaphis foeniculi* (Pass.).

Genus BRACHYCAUDUS Van der Goot

(Type : *Aphis myosotidis* Koch)

1913. *Brachycaudus* Von der Goot, *Tijd. voor Ent.*, LVI, p. 97.

Compound eyes with a visible triommatidion. Frontal tubercles small or absent. Antennae usually 6-segmented with secondary rhinaria present on 3rd segment only, on 3rd and 4th or sometimes on 3rd, 4th and 5th ; unguis from 1.5 to 6 times as long as basal part. Apical rostral segment bearing 4 to 10 secondary hairs. First tarsal segments with 3 : 3 : 3 or 3 : 3 : 2 hairs. Wing venation normal. Abdomen with a well-developed dorsal black patch and often also with ventro-lateral sclerites ; lateral sclerites often present on segments 2 to 5. Siphunculi of medium length or short, cylindrical or tapering, 1/30 to 1/6 as long as the body and with a very typical non-reticulated apical structure. Cauda short usually semi-circular ; little if any longer than its basal width and bearing 4 to 13 hairs.

Represented in Egypt by two species, namely, *B. amygdalinus* (Schouteden) and *B. helichrysi* (Kaltenbach).

KEY TO SPECIES

1. Siphunculi shorter than cauda in length ... *amygdalinus* Schout.
— Siphunculi longer than cauda in length ... ... *helichrysi* Kalt.

Brachycaudus amygdalinus (Schouteden)

1905. *Brachycaudus amygdalinus* Schouteden, after Eastop (1958), Colonial Office, Hull Printers Limited, London.
1926. *Anuraphis aegyptiaca* Hall, Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68, pp. 1-62.
1926. *Brachycaudus amygdalinus* (Schouteden), after Eastop (1958), Colonial Office, Hull Printers Limited, London.

Recorded and described from Egypt by HALL (1926) under the name *Anuraphis aegyptiaca* living on *Rumex* sp.

Antennal formula 6-3-4-5 ; unguis about 2.8 times as long as basal part ; number of rhinaria on 3rd antennal segment 13 ranging 10-13, distributed over its whole length ; 4th and 5th antennal segments without scondary rhinaria. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 3 hairs. Abdomen with well-developed rectangular dorsal patch extending almost to the lateral sclerites ; lateral sclerites large with only 2 or 3 hairs ; post- and ante-siphuncular sclerites present ; 7th and 8th tergites distinct. Siphunculi very short. Cauda semi-circular with about 6 hairs.

MATERIAL : One specimen caught on the light trap, 26 March 1958, Koubba Palace (authors' coll.) ; 3 specimens on *Rumex* sp., 14 April 1924, Giza (coll. Min. Agr.).
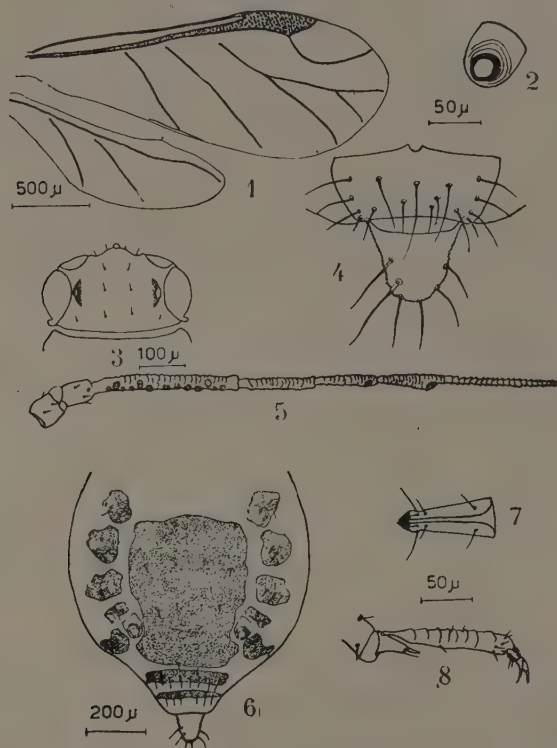

FIG. 40: *Brachycaudus amygdalinus* (Schouteden). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view) ; 4. Cauda and anal plate (ventral view) ; 5. Antenna; 6. Abdomen (dorsal view) ; 7. Apical rostral segment (dorsal view) ; 8. Hind tarsus.

Brachycaudus helichrysi (Kaltenbach)

1843. *Aphis helichrysi* Kaltenbach, after Eastop (1958), Colonial Office, Hull Printers Limited, London.
1922. *Anuraphis cinerarae* Theobald, *Bull. Soc. Roy. Ent. Egypte*, VII, p. 39.
1922. *Anuraphis cyani* Theobald, *Bull. Soc. Roy. Ent. Egypte,* VII, p. 39.
1922. *Anuraphis helichryst,* after Hall (1926), Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68, pp. 1-62.
1922. *Brachycaudus helichrysi,* after Eastop (1926). Colonial Office, Hull Printers Limited, London.

First recorded in Egypt by THEOBALD (1922) on artichoke under
the name of *Anuraphis cinerarae* (n. sp.) and on corn flower under
the name of *Anuraphis cyani* (n. sp.). HALL (1926) studied these two
species and found that they are synonyms to *Anuraphis helichrysi*
(Kalt.).

FIG. 41: *Brachycaudus helicrysi* (Kaltenbach). — 1. Fore and hind wings;
2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view);
5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view);
8. Hind tarsus.

Antennal formula 6-3-4-5 ; unguis about 3.2 times as long as basal
part ; number of rhinaria on 3rd and 4th antennal segments is 20
ranging 12-24 and 2 ranging 0-4, respectively ; 5th antennal segment
without secondary rhinaria.   First hind tarsal segment with 3 hairs.
Abdomen with a well-developed dorsal patch ; lateral sclerites pre-
sent ; ante- and postsiphuncular sclerites present and attached with
the dorsal patch ; 7th and 8th tergites present.   Siphunculi rather
short and tapering.   Cauda semi-circular bearing about 7 hairs.

MATERIAL : One specimen on *Anethum* sp., April 1957, Koubba Palace (authors' coll.) ; 4 specimens on *Cineraria* sp., 24 Jan. 1921, Cairo (coll. Min. Agr.).

Genus BREVICORYNE Van der Goot

(Type : *Aphis brassicae* L.)

1915. *Brevicoryne* Van der Goot, Beiträge z. Kennt. Holl. Blattläuse, p. 245.
1916. *Oedisiphum* Van der Goot, Zur Kenntniss der Blattläuse Java's p. 122.

Living insects covered with wax. Head without prominent frontal tubercles ; Frons convex but with no distinct median tubercle. Antennae 6-segmented, measuring 1/2 of the length of the body and armed with subcircular rhinaria. Wing venation normal. Siphunculi short, not much longer than the cauda and swollen in the middle. Cauda short, triangular with 6 to 9 hairs. 8th targite with 6 to 15 hairs.

Represented in Egypt by one species only, namely *B. brassicae* L.

Brevicoryne brassicae (Linnaeus)

1758. *Aphis brassicae* L., Systema Naturae (Editio decima), p. 452.
1914. *Siphocoryne brassicae* Davis, *Canad. Ent.*, XLIV, pp. 231-234.
1915. *Brevicoryne brassicae* Van der Goot, Beiträge z. Kennt. Holl. Blattläuse, p. 245.

A cosmopolitan species commonly known as cabbage aphis. First recorded in Egypt by WILLCOCKS (1922) on cabbage, and by HALL (1926) on turnip, cauliflower, radish and ornamental stocks.

Body and appendages, general colour green, covered dorsally and ventrally with white powdery waxy secretions.

Head : Black with black eyes and antennae. Antennal formula (6-3)-4-5 ; unguis about 3.7 times as long as the basal part ; rhinaria on 3rd segment, rather tuberculate, irregular in shape, averaging 60 in number and ranging from 35 to 70 ; 4th and 5th antennal segments without secondary rhinaria. Proboscis black, apical rostral segment with 8 secondary hairs. Acrotergite green.

Thorax : Prothorax black with a green intersegmental membrane between it and the mesothorax ; meso- and metathorax black. Wing venation normal. Legs black, except the basal parts of femora which are whitish and translucent. First hind tarsal segment with 3 hairs.

Abdomen : Green. Lateral sclerites black ; black transverse sclerites (broken in the middle) present on 3rd, 4th and 5th segments ; 3 other longitudinal (continuous) sclerites present posteriorly ; ante-

and postsiphuncular sclerites absent. Siphunculi black, short and swollen. Cauda black and triangular.

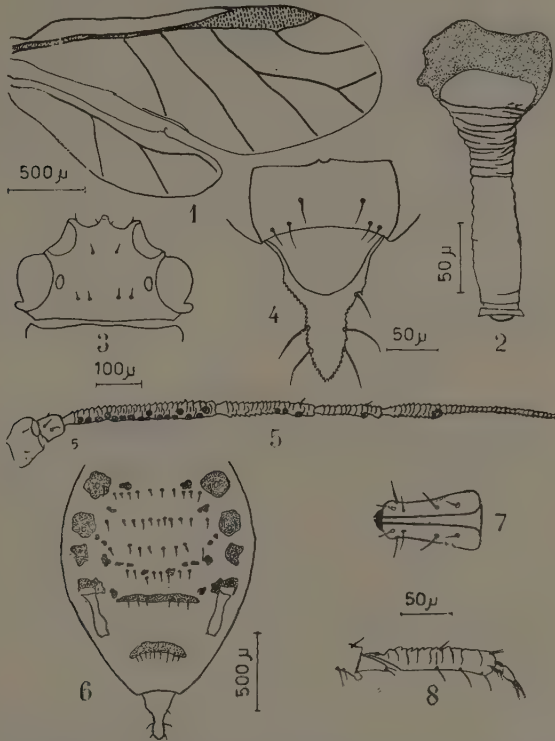Fɪɢ. 42: *Brevicorine brassicae* (L.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

The present writers could also collect 3 alate males caught on the light trap for the first time in Egypt, which were kindly identified by Dr. EᴀsTOP of the British Museum. They are similar to the alate viviparous females except in the following :

1. Antennal formula 6-3-4-5.
2. Unguis about 4.7 times as long as the basal part.
3. Number of rhinaria is very high ; 3rd, 4th and 5th segments with rhinaria ranging from 70-84, 11-23 and 13-18, respectively.

MALE GENITALIA : Claspers short, conical slender lobes about 55 μ in length, ranging from 44 to 66 μ. Aedeagus, tubular with a broad base, moderately long about 105 μ in length ranging from 99 to 110 μ.

MATERIAL : 10 specimens of alate viviparous females on cabbage, Jan. 1957, Cairo ; and 3 alate males caught on the light trap, March 1958, Koubba Palace (authors' cell.).

Genus LIPAPHIS Mordwilko

(Type : *Aphis erysimi* Kaltenbach)

1928. *Lipaphis* Mordw., in Filipjev, j. N., Keys to the Insects of European Russia: 200. Novaya Dereynya, Moscow.

Frontal tubercles moderately developed, the median tubercle often well developed. Antennae 6-segmented, about 1/4-3/4 as long as the body ; unguis about 1.75-4.5 times as long as the basal part ; secondary rhinaria on 3rd, usually also on 4th and sometimes on 5th antennal segments. Rostrum reaching to the mid or hind coxae. Apical rostral segment usually shorter than 2nd hind tarsal segment and with only 2 to 5 secondary hairs.

First tarsal segments with 3 : 3 : 2 hairs.

Abdomen usually with only very weakly developed dorsal pigmentations except on 6 to 8 tergites. Siphunculi weakly clavate, 1/9 to 1/5 as long as the body and about equal to twice as long as the cauda which usually bears only 5 hairs.

Lipaphis has only been accepted by European authors, others usually placing their species in *Rhopalosiphum* (EASTOP, 1958).

Represented in Egypt by one species, namely *L. erysimi pseudobrassicae* (Davis).

Lipaphis erysimi pseudobrassicae (Davis)

1914. *Aphis pseudobrassicae* Davis, *Canadian Entomologist*, XLVI, p. 231.
1918. *Aphis mathiolellae* Theobald, *Bull. Ent. Res.*, XI, p. 65.
1928. *Lipaphis erysimi pseudobrassicae* (Davis), after Eastop (1958), Colonial Office, Hull Printers Limited, London.
1931. *Rhopalosiphum pseudobrassicae* Hottes and Frison, Dept. Reg. and Educ., Div. Nat. Hist. Survey, Urbana, Illinois, XIX (3), p. 240.

A common sub-species on Cruciferous plants. It was first recorded in Egypt by THEOBALD (1918) under the name of *Aphis mathiolellae*. He stated that it was very similar to Aphis mathiole, but can be distinguished by the shape and number of rhinaria.

EASTOP (1958) stated that this sub-species differs from the species
L. *esrysimi* (Kalt., 1843) only in :

1. In colour which is probably not of importance.

2. *L. erysimi* (Kalt.) is not a pest of cabbages in Europe, whereas
pseudobrassicae (Davis) is a well-known cabbage aphid in America
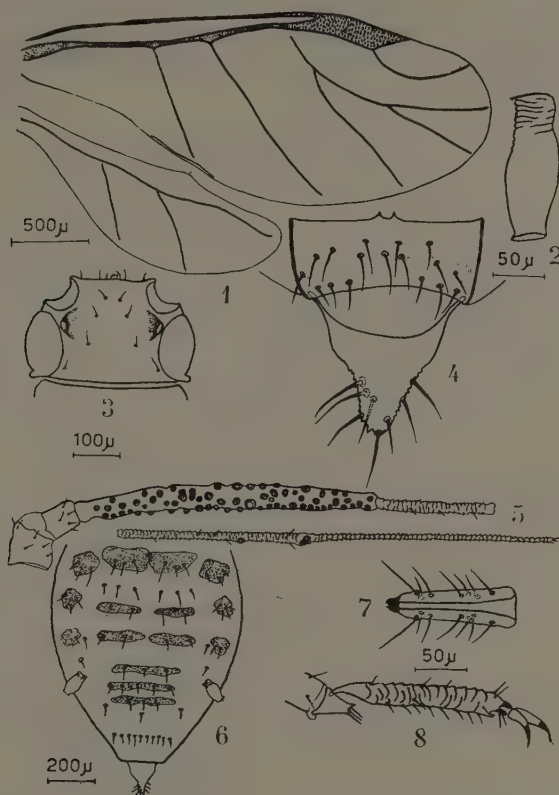and in the tropics.
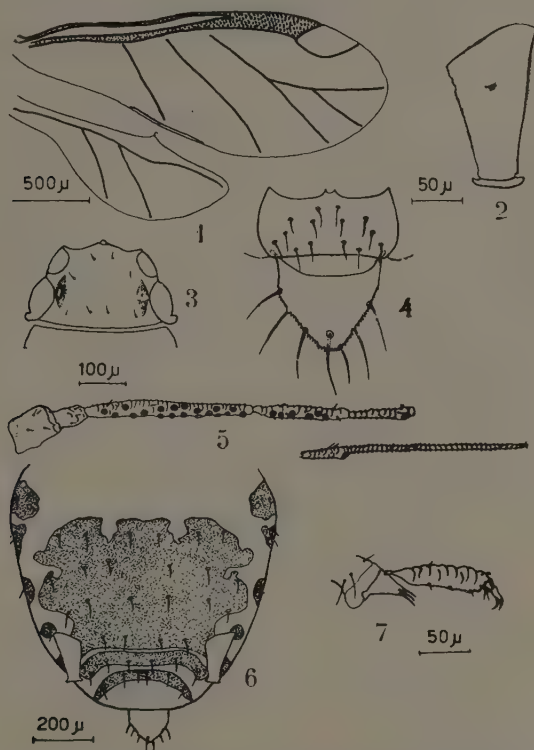
FIG. 43: *Lipaphis erysimi pseudobrassicae (Davis)*. — 1. Fore and hind wings;
2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view);
5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view);
8. Hind tarsus.

Antennal formula 6-3-4-5 ; unguis 2.5 times as long as the basal
part ; rhinaria on 3rd, 4th and 5th segments ranging from 14-26, 2-10
and 1-2, respectively. Apical rostral segment with 4 secondary hairs.
First hind tarsal segment with 2 hairs ; a rhinarium is present on the
basal part of the 3nd hind tarsal segment. Three abdominal lateral

sclerites present anterior to the siphunculi, each within a tubercle ;
intersegmental sclerites present. Siphunculi encircled at the base
with a sclerite. The 6th and 8th abdominal tergites distinctly sclero-
tised.

MATERIAL : 9 specimens caught on the light trap, March 1958,
Koubba Palace (authors' coll.).

Genus NASONOVIA Mordwilko

(Type : *Aphis ribicola* Kaltenbach)

1914. *Nasonovia* Mordwilko, Faune Russie, Ins. Hémipt., I (1), pp. 71-72.

Frontal tubercles moderately developed, slightly diverging ante-
riorly ; median frontal tubercle often well developed. Antennae bear-
ing conspicuous hairs, 6-segmented as long as or longer than the body ;
secondary rhinaria present on 3rd and 4th antennal segments. Apical
rostral segment with 6 to 12 secondary hairs. First tarsal segments
with 4 : 4 : 4 ; 3 : 5 : 3 or 3 : 3 : 2 hairs. Wing venation normal.
Abdomen with dorsal pigmentation. Siphunculi of *Nasonovia* s. s.
cylindrical, of *Hyperomyzus* and other sub-genera, clavate ; apex of
siphunculi with a characteristic annular constriction before the dis-
tinct flange. Cauda spatulate near the base and bearing 7 or 8 hairs.

Represented in Egypt by one sub-genus only, namely *Hyperomy-
zus* Börner.

Sub-Genus HYPEROMYZUS Börner

(Type : *Aphis lactucae* Linnaeus)

Characterised by the first tarsal segments bearing 3 hairs ; siphun-
culi clavate.

Represented in Egypt by one species only, namely *Nasonovia
(Hypromyzus) lactucae* (L.).

Nasonovia (Hyperomyzus) lactucae (L.)

1758. *Aphis lactucae* Linnaeus, Systema Naturae, ed. 10, p. 452.
1801. *Aphis sonchi* Paula v. Schrank, partim, Fauna Boica, II, p. 120.
1854. *Rhopalosiphum erraticum* Koch, Die Pflanzenläuse Aphiden, pp. 35-36.
1870. *Rhopalosiphum lactucae* Walker, Zoologist, LIII, p. 1997.
1879. *Rhopalosiphum ribis* Buckton, Mono. Brit. Aphides, II, p. 9.
1887. *Rhopalosiphum dianthi* Oestlund, Geol. Nat. Hist. Survey Minnesota,
        Bull. 4, p. 76.
1887. *Nectarophora ribis* Oestlund, Geol. Nat. Hist. Survey Minnesota, Bull. 4,
        p. 85.
1896. *Rhopalosiphum ribis* Mordw., *Warszawskija Univ. Iswestja*, pp. 3-9.
1900. *Siphanophora lactucae* Schouteden, *Ann. Soc. Ent. Belg.*, XLIV, pp. 115-
        119.

1920. *Amphorophora lactucae* Quaintance and Baker, U.S. Dept. Agric., Farmers Bull. No. 1128, p. 30.

1923. *Amphorophora triticum* Theobald, South East. Agric. Coll., Adu Res. Dept., Bull. 2, p. 7.

1925. *Amphorophora cosmopolitana* Mason, *Proc. U.S. Nat. Mus.,* XLVII (20), pp. 16-26.

1926. *Amphorophora cosmopolitanus* Theobald, Aph. Great Britain, I, pp. 199-204:

1931. *Rhopalosiphoninus lactucae* Börner, *Ans. Schädlingsk.,* VII, pp. 10-11.

1933. *Hyperomyzus lactucae* Börner, *Kl. Mitt. über Blattl.* (ed. Börner), p. 2.

1958. *Nasonovia (Hyperomyzus) lactucae,* Eastop, Colonial Office, Hull Printers Limited, London.
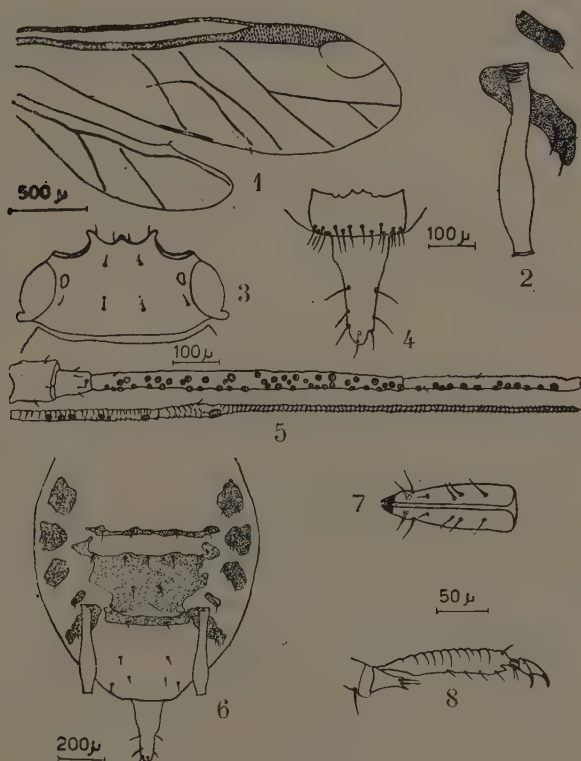
FIG. 44: *Nasonovia (Hyperomyzus) lactucae* (L.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

First recorded in Egypt by HALL (1926) on *Sonchus oleracea* under the name *Rhopalosiphum lactucae.*

Antennal formula 6-3-4-5 ; number of rhinaria on 3rd, 4th and 5th segment ranging 36-56, 9-21 and 3-8, respectively ; rhinaria characterised by being subcircular and not equal in size ; pedicel characterised by the presence of 1-3 small rhinaria.

Abdomen with three pairs of distinct small tubercles occurring in the lateral abdominal sclerites and located anterior to the siphunculi, with a variable number of setae surrounding them. Post- and antesiphuncular sclerites present, the former being larger. A large pigmented dorsal patch present. Apical rostral segment with 6 secondary hairs. First hind tarsal segment with 2 hairs.

MATERIAL : One specimen on *Nicotiana* sp.; April 1956, Koubba Palace, another one caught on the light trap, March 1958 (authors' coll.) ; 6 specimens on Sonchus oleracea, April 1924, Giza (coll. Min. Agric.).

Genus CHOMAPHIS Mordwilko

(Type : *Chomaphis mira* Mordwilko)

1928. *Chomaphis* Mordwilko, after Eastop (1958), Colonial Office, Hull Printers Limited, London.

Living insects covered with grey wax.

Head with frontal tubercles variably developed ; small in the East African species (EASTOP, 1958). Compound eyes with a conspicuous triommatidion. Antennae 6-segmented ; secondary rhinaria present on 3rd, 4th and often also on 5th antennal segments ; unguis usually 3 to 4 times as long as the basal part. Apical rostral segment normal in shape and usually with only 2 to 6 secondary hairs. Wing venation normal. First tarsal segments with 3 : 3 : 3 or 3 : 3 : 2 hairs.

Abdomen with conspicuous lateral abdominal tubercles, pointed in sub-genus *Pomaphis* and broadly rounded in the sub-genera *Chomaphis* s.s. and *Dysaphis*. 7th and 8th targites often with a pair of mid-dorsal (spinal) tubercles. Siphunculi rather short. Cauda short, triangular in *Pomaphis* s. s., pentagonal in *Chomaphis* and *Dysaphis*, usually with only 4 to 6 hairs (EASTOP, 1958).

Represented in Egypt by three species, namely *inculata* Walker, *foeniculus* Theo. and *tulipae* B. d. F., related to one sub-genus, namely *Dysaphis* Börner. Sub-genus *Pomaphis* on the other hand is not represented in Egypt, while sub-genus *Chomaphis* s. s. is represented by *cynarae* Theo. specimens of which were unfortunately unavailable to the writers.

Sub-Genus DYSAPHIS Börner

(Type : *Aphis angelicae* Börner)

1931. *Dysaphis* Börner, after Eastop (1958), Colonial Office, Hull Printers Limited, London.

KEY TO SPECIES

1(2) Number of rhinaria on 4th antennal segment more than 20. Siphunculus more than 1.5 times as long as 2nd hind tarsal segment ... ... *inculata* Walker
— Number of rhinaria on 4th antennal segment less than 20. Siphunculus about as long as the 2nd hind tarsal segment 2
2(1) Dorsal abdominal black patch with an almost straight front margin making a right-angle with the sides. Apical rostral segment often with 2 secondary hairs ... ... *foeniculus* Theo.
— Dorsal abdominal black patch with a rounded front margin, not making a distinct angle with the sides. Apical rostral segment often with 4 secondary hairs ... ... *tulipae* B. d. F.

Chomaphis (Dysaphis) inculata (Walker)

1922. *Anuraphis apiifolia* Theobald, *Bull. Roy. Ent. Egypte,* VII, p. 39.
1931. *Aphis angelicae* Börner, after Stroyan (1953), *Proc. R. ent. Soc. London* (B), XXII (5-6), p. 95.
1938. *Aphis ferruginea-striata* Essig, after Stroyan (1953), *ibid.*
1938. *Dysaphis aptifolia* (Theo.), after Stroyan (1953), *ibid.*
1938. *Dysaphis ferruginea-striata* (Essig), after Stroyan (1953), *ibid.*
1938. *Chomaphis (Dysaphis) inculata* (Walker), after Eastop (1958), Colonial Office, Hull Printers Limited, London.

First recorded in Egypt by WILLCOCKS in 1918 on celery (*Apium graveolens*) and described by THEOBALD (1922) under the name *Anuraphis apiifolia.* HALL (1926) collected it again from fennel.

Recently, STROYAN (1953) considered *D. apiifolia* (Theo.) and *D. ferruginea-striata* (Essig) as synonyms to *D. inculata* (Walker).

Antennal formula 3-6-4-5 ; unguis about 3.5 times as long as the basal part ; number of rhinaria on 3rd, 4th and 5th antennal segments is 80 ranging 68-85, 28 ranging 22-35 and 3 ranging 1-5, respectively. Apical rostral segment with 4 secondary hairs. First hind tarsal segment with 3 hairs.

Lateral abdominal tubercles conspicuous, often 2-4 spinal tubercles present. Dorsal abdominal dark patch often rather broken

anteriorly and often narrowed towards the anterior margin, though this is not a distinct feature (STROYAN. 1953).

MATERIAL : 2 specimens on Fennel, March 1924, Giza (coll. Min. Agric.).
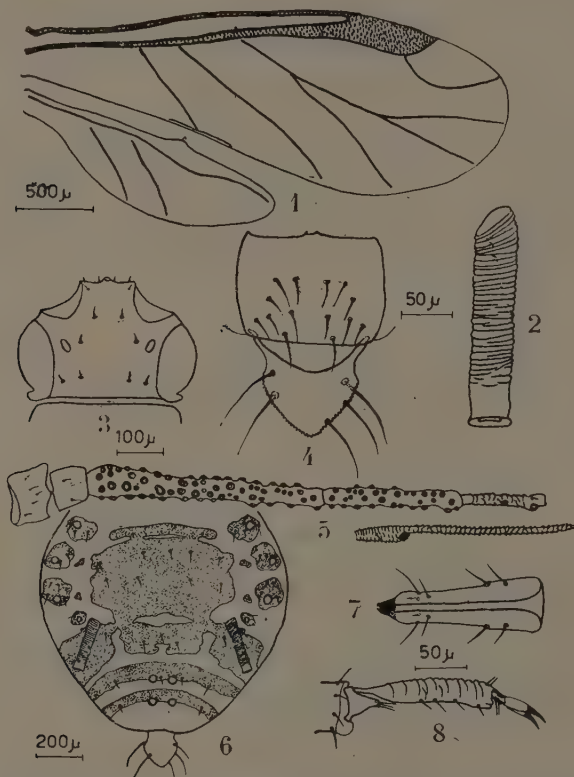
FIG. 45: *Chomaphis (Dysaphis) inculata* (Walker). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Chomaphis (Dysaphis) foeniculus (Theobald)

1922. *Anuraphis foeniculus* Theo., *Bull. Soc. Roy. Ent. Egypte*, VII, p. 39.
1938. *Aphis ferruginea-striata* Essig, *Hilgardia*, XI, pp. 459-492, partim.
1948. *Dysaphis ferruginea-striata* Hille Ris Lambers, *Trans. R. Ent. Soc. Lond.*, IC, pp. 269-289.
1953. *Dysaphis foeniculus* Stroyan, *Proc. R. Ent. Soc. Lond.* (B), XXII (5-6), p. 95.
1953. *Chomaphis (Dysaphis) foeniculus* (Theo.), after Eastop, (1958), Colonial Office, Hull Printers Limited, London.

First recorded in Egypt by Willcocks on fennel in 1918 and described by THEOBALD (1922) and HALL (1926).

FIG. 46: *Chomaphis (Dysaphis) foeniculus* (Theo.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Antennal formula (6-3)-4-5 ; unguis about 2.5 the basal part ; number of rhinaria on 3rd and 4th segments 30 ranging 26-24 and 7 ranging 4-8, respectively ; 5th antennal segment without secondary rhinaria. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 3 hairs. Ante- and postsiphuncular sclerites present ; dorsal abdominal black patch with the almost straight front margin perpendicular to the sides. One to four spinal tubercles present on 7th and 8th tergites.

MATERIAL : One specimen on fennel, March 1924, Giza and another one on *Anethum* sp., March 1921, Giza (coll. Min. Agric.).

Chomaphis (Dysaphis) tulipae (B. d. F.)

1841. *Aphis tulipae* Boyer de Fonscolombe, *Ann. Soc. Ent. France,* X (3), p. 167.
1953. *Dysaphis tulipae* Stroyan, *Proc. R. Ent. Soc. Lond.* (B), XXII (5-6), p. 95.
1953. *Chomaphis (Dysaphis) tulipae* (B. d. F.), after Eastop (1958), Colonial Office, Hull Printers Limited,, London.

The writers record this species for the first time in Egypt. Spe-
cimens were collected by a light trap and were kindly identified by
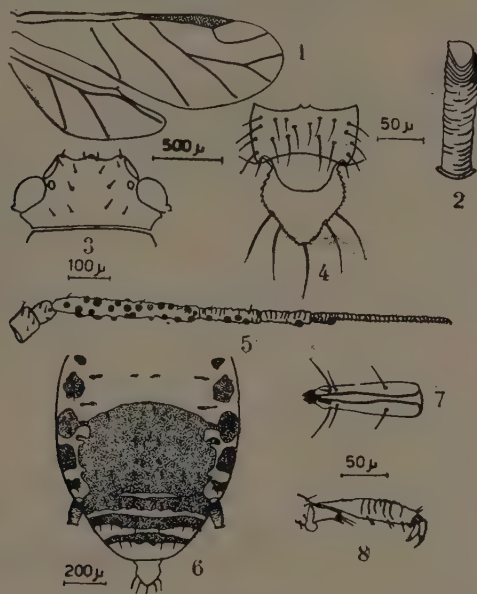Dr. EASTOP of the British Museum.
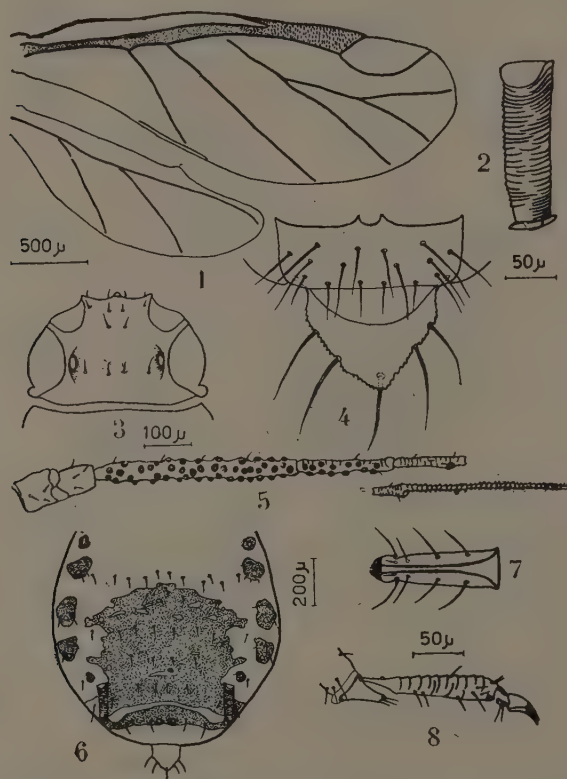
FIG. 47: *Chomaphis (Dysaphis) tulipae* (B. d. F.). — 1. Fore and hind wings;
2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view);
5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view);
8. Hind tarsus.

This species is so similar to *D. foeniculus* that it is not easy to
separate them (STROYAN, 1953 and EASTOP, 1958).

Biometrics of the writers' specimen for *D. tulipae* were nearly the
same as those for *D. foeniculus*, except the 3rd and 6th antennal seg-
ments which were slightly longer and the number of secondary rhina-
ria which was higher in *tulipae* than in *foeniculus*. 3rd, 4th and 5th

antennal segments of tulipae with 49 ranging 43-58, 13 ranging 9-18 and 1 ranging 1-2 rhinaria, respectively. This difference may be due to the few number of examined slides (only two) which were available for *foeniculus*.

This species differs morphologically from *foeniculus* in the following :

1. Dorsal black patch smaller, with a rounded front margin, not making a right angle with the sides ; usually with 3 to 6 spinal tubercles (only rarely with 3 or more in *foeniculus*) (EASTOP, 1958).

2. Apical rostral segment with 4 secondary hairs (2 only in *foeniculus*).

MATERIAL : 10 specimens caught on the light trap, Feb. 1958, Koubba Palace (authors' coll.).

Chomaphis cynarae (Theobald)

1915. *Aphis cynarae* Theobald, *Bull. Ent. Res.*, VI, p. 103.
1926. *Anuraphis cynarae* Hall, Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68, pp. 1-62.
1926. *Chomaphis cynarae* (Theo.), after Eastop (1956), Colonial Office, Hull Printers Limited, Londonl.

Described from Egypt by THEOBALD (1915) from samples feeding on artichoke (*Cynara scolymus*) (WILLCOCKS' collection). HALL (1926), after examining slides from THEOBALD's collection, transferred it to the genus *Anuraphis* for the nature of the cauda and tip if the abdomen. More recently EASTOP (1958) stated that *Chomaphis lappae* (Koch) is closely related to *cynarae* Theo.

Unfortunately specimens of this species were not available to the present writers. Description as collected from literature is briefly as follows :

Antennal formula 3-6-4-5 ; unguis 3 times as long as basal part ; number of rhinaria on 3rd and 4th antennal segments ranging 35-50 and 14-18, respectively. Siphunculi cylindrical, little longer than the cauda, which is bluntly cone-shaped with 4 hairs.

2. Tribe APHIDINI

Represented in Egypt by the two well-defined Sub-Tribes *Aphidina* and *Rhopalosiphina*.

KEY TO THE SUB-TRIBES

1. 1st and 7th abdominal segments always with lateral abdominal tubercles ; tubercles of 7th segment often placed posterior and slightly outer to the spiracle of that segment. Frontal tubercles small or absent. Usually on dicotyledons, rarely on monocotyledons and if so very rarely on grasses or sedges ..., ... *Aphidina*

— Lateral abdominal tubercles rarely completely absent but when present the tubercles of the 7th segment are often placed posterior and slightly inner to the spiracle of that segment. Head often with small projections on the inner sides of the small frontal tubercles. Mostly on grasses or sedges, rarely on water-lilies, aquatic monocotyledons and Rosaceae ... ... *Rhopalosiphina*

a. Sub-Tribe *Aphidina*

Represented in Egypt by two genera, namely *Brachyunguis* Das and *Aphis* L.

KEY TO THE GENERA

1. Unguis about 0.5 to 1.5 times as long as the basal part. Siphunculi and cauda also short. On Compositae ... ... *Brachyunguis* Das.

— Unguis more than 1.75, usually 2.25-3.5 times as long as the basal part. Polyphagus ... ... *Aphis* L.

Genus BRACHYUNGUIS Das

(Type : *Brachyunguis harmalae* Das)

1918. *Brachyunguis* Das, after Eastop (1958), Colonial Office, Hull Printers Limited, London.

Frontal tubercles, not well developed. Antennae 6-segmented ; unguis 0.5 to 1.5 times as long as the basal part. Fore wing with M twice branched, hind wing with both M and Cu present. Siphunculi and cauda short. On *Compositae*.

Very similar to genus *Aphis* but unguis, siphunculi and cauda short ; cauda usually bearing numerous hairs.

Represented in Egypt by one species only, namely *B. tamaricis* (Licht.).

Brachyunguis tamaricis (Lichtenstein)

1885. *Aphis tamaricis* Lichtenstein, *Bull. Soc. Ent. France* (6), pp. 179-180.

First recorded in Egypt by HALL (1926) as a new species under the name *Pergandeidia tamaricifoliae* on *Tamarix* sp. and *Calotrips procera*. The present writers collected specimens by a light trap ; they were kindly identified by Dr. EASTOP of the British Museum as *B. tamaricis* (Licht.) and were found to be similar to HALL's paratypes.

HALL (1926) stated that specimens of *P. tamaricifoliae* differed from the original description and the type of THEOBALD in the following :

1. Number of rhinaria on the 3rd antennal segment ranges from 2-8, the usual being 6 or 7.

2. None of HALL's specimens showed a rhinarium on 4th antennal segment as it is present in *A. tamaricis* Theo.

3. The single secondary rhinarium on 5th antennal segment is absent while present in *A. tamaricis* Theo.

4. The unguis is only very slightly more than half the length of the base.

5. The cauda is more acuminate.

6. Siphunculi in some specimens are shorter and stouter. and more expanded basally.
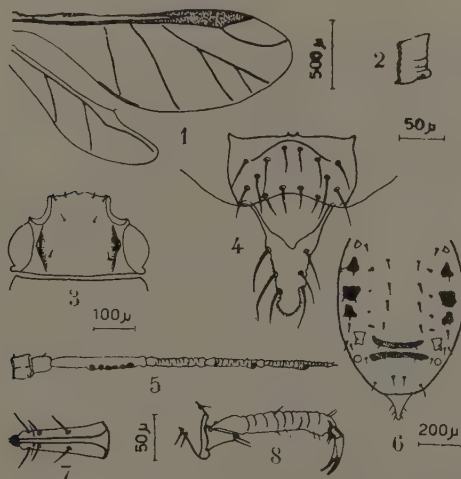

FIG. 48: *Brachyunguis tamaricis* (Licht.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

The present writers found that these characters are also present in *B. tamaricis* (Licht.) in an intermediate condition between *P. tamaricifoliae* and *A. tamaricis* Theo. Thus the number of rhinaria was on 3rd antennal segment ranging 4-8. A secondary rhinarium present on 4th and 5th antennal segment. Unguis only very slightly more than half the length of the basal part. Cauda acuminate. Siphunculi in some specimens are shorter and stouter and more expanded basally. From the above notes it is concluded that *A. tamaricis* Theo., *B. tamaricis* (Licht.) and *P. tamaricifoliae* Hall are not distinct species but only possessing variation in characters within the same species.

Antennal formula 3-6-5-4 ; unguis about half as long as the basal part ; number of rhinaria on 3rd, 4th and 5th antennal segments is 6 ranging 4-8, 0.5 ranging 0-1 and 1.5 ranging 1-2, respectively. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 2 hairs only. Siphunculi 94μ in length ranging 66-121μ.

MATERIAL : 2 specimens caught on the light trap, March 1958, Koubba Palace (authors' coll.) ; 5 specimens on *Tamarix* sp., March 1924, Cairo (coll. Min. Agric.).

Genus APHIS Linnaeus

(Type : *Aphis sambuci* L.)

1758. *Aphis* Linnaeus, Systema Naturae, 10th ed., p. 451.
1817. *Loxeratea* Rafinesque, *Am. Mag. and Crit. Review*, I, p. 361.
1907. *Uraphis* Del Guercio, *Redia,* IV, p. 192.
1907. *Microsiphon* Del Guercio, *Redia,* IV, p. 192.
1913. *Myzaphis* Van der Goot, *Tijd. coor Ent.,* LVI, p. 96.
1913. *Stenaphis* Del Guercio, *Redia,* IX, p. 185.
1917. *Abura* Matsumura, *Jour. Coll. Agr. Tohoku Univ.,* VII (6), p. 407.
1917. *Arimakia* Matsumura, *Jour. Coll. Agr. Tohoku Univ.,* VII (6), p. 405.

Head with small or absent frontal tubercles. Triommatidion present. Antennae 6-segmented and armed with rounded rhinaria ; secondary rhinaria present on 3rd ; 3rd and 4th ; or on 3rd, 4th and 5th segments ; unguis 1.5-4 times as long as the basal part. Apical rostral segment normal in shape and usually bearing only a few secondary hairs. Wing venation normal. Mid-thoracic furca sessile or consisting of two separate arms. First tarsal segments with usually 3 : 3 : 2, rarely 3 : 3 : 3 hairs. Siphunculi cylindrical or tapering and with only a small flange. Cauda usually short.

This is the largest genus of aphids. 700 sepcies were described and related to this genus, however, many of these are now placed in other genera.

In Egypt, HALL (1926) recorded 21 species, a number which is reduced now to 12. Three species namely *A. maidis, A. pseudobrassicae* and *A. splendens* were transferred to other genera and their recent nomenclature are *Rhopalosiphum maidis, Lypathis erysimi pseudobrassicae* and *Rhopalosiphum rufiabdominalis,* respectively. *A. cistiella* and *A. ficus* are also considered as synonyms to *A. gossypii* while *A. punicellae* is a synonym to *A. punicœ* (= *A. durantae*). *A. laburni* and *A. pomi* are not actually present. The rest of the species (12) are listed here below in the key.

KEY TO THE SPECIES

1(2) Cauda triangular. Apical rostral segment acuminate. 3rd antennal segment with crowded rhinaria ... ... *verbasci* Schrank
— Cauda not triangular. Apical rostral segment normal. Rhinaria often not crowded 2
2(1) Siphunculi about as long as either the unguis or the 3rd antennal segment. Postsiphuncular sclerite present and large. Unguis about 3 times as long as the basal part ... ... *nerii* B. d. F.
— Siphunculi is not as long as the unguis or the 3rd antennal segment. Postsiphuncular sclerites often small when present. Unguis variable 3
3(2) Unguis about equal or longer than 3 times as long as the basal part. Cauda bearing about 15 hairs ... ... *compositae* Theo.
— Unguis less than 3 times as long as the basal part. Cauda usually with less than 15 hairs 4
4(3) Secondary rhinaria only confined to 3rd antennal segment ... 5
— Secondary rhinaria present on 3rd and 4th or on 3rd, 4th and 5th antennal segments 6
5(4) 4th and 5th antennal segments longer than the 6th segment. Secondary rhinaria variable in size 7
— 4th and 5th antennal segments about equal or shorter than the 6th segment. Secondary rhinaria nearly equal in size .. .. *gossypii* Glover
6(4) Siphunculi longer than the unguis ... ... *genistae* Scop.
— Siphunculi shorter than the unguis 8
7(5) Siphunculi shorter than 3rd antennal segment ... ... *medicaginis* Koch
— Siphunculi longer than 3rd antennal segment *craccivora* Koch

8(6)   Total number of secondary rhinaria on 3rd, 4th ond 5th antennal segments 10 or less 9

—   Total number of secondary rhinaria on 3rd, 4th and 5th antennal segments more than 10 10

9(8)   Siphunculi with normal imbrication. 3rd antennal segment about 1.5 times as long as the 4th segment which is about as long as the 5th   ... ... *punicae* Pass.

—   Siphunculi often with spinal imbrication. 3rd antennal segment about twice as long as the 5th. 4th segment about 1.25 times as long as the 5th   ... ... *zizyphi* Theo.

10(8) Unguis about twice as long as the basal part. 3rd antennal segment about twice as long as the 5th segment *acetosella* Theobald

—   Unguis about 2.5 times as long as the basal part and 3rd antennal segment about 1.7 times as long as the 5th segment 11

11(10) On Stocks   ... ... *mathiolae* Theo.

—   On Rumex and Poppies   ... ... *ruminis* L.

N.B. — The latter 2 species are more likely to be host varieties.

Aphis verbasci Schrank

1801. *Aphis verbasci* Scrank, after Eastop (1958), Colonial Office, Hull Printers Limited, London.
1911. *Aphis phlomoidea* Del Guercio, after Eastop (1958), Colonial Office, Hull Printers Limited, London.
1918. *Aphis buddleiae* Theobald, *Bull. Ent. Res.,* VIII. p. 273.

A very distinct lemon coloured species. First identified in Egypt by THEOBALD (1918) on *Buddleia madagascariensis* (WILLCOCKS' collection). HALL (1926) collected this species on the same host plant. EASTOP (1958) stated that *A. buddleiae* Theo. is a synonym to *A. verbasci* Schrank.

Antennae 6-segmented with subcircular crouded rhinaria of varied sizes on 3rd antennal segment ; antennal formula 6-3-4-5 ; unguis about 2.6 times as long as the base. 5th antennal segment without secondary rhinaria ; number of rhinaria on 3rd and 4th antennal segment is 17 ranging 9-23 and 5 ranging 1-8, respectively. Apical rostral segment with 4 secondary hairs. First hind tarsal segment with 2 hairs. Lateral abdominal sclerites present ; abdominal tubercles present on 1st and 7th segments ; post-siphuncular sclerites present. Cauda triangular with about 11 hairs. 7th and 8th tergites present.

MATERIAL : One specimen on *Buddleis madagascariensis*, May 1924, Gezireh ; 5 specimens on *Osheiri*, March 1921, Giza (coll. Min. Agr.).
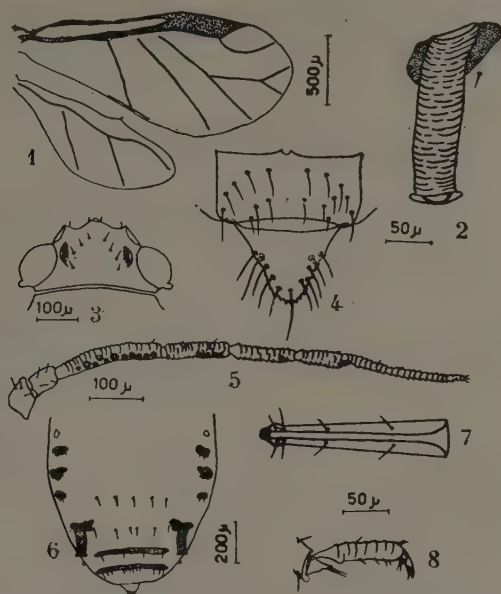
FIG. 49: *Aphis verbasci* Schrank. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Aphis nerii Boyer de Fonscolombe

1845. *Aphis nerii* B. d. F., *Ann. Soc. Ent. France*, X, p. 179.
1863. *Aphis lasclepiadis* Pass., Aphid. Ital., pp. 22-25.
1879. *Aphis luctescene* Monell, *Bull. U.S. Geol. and Geog. Survey of the Territories*, V (1), article 1, p. 23.
1914. *Siphonophora lept adeniae* Vuillet and Vuillet, after Eastop (1958), Colonial Office, Hull Printers Limited, London.

A conspicuous bright yellow aphid. First recorded from Egypt, at Cairo, by THEOBALD (1913), on *Nerium oleander, Asclepias corunti, A. grandiflora, Citrus aurantii* and tuberosa ; and on *Calotropis procera* at Bahariya Oasis (WILLCOCKS' collection). No redescription or drawing were given before in Egypt.

General colour bright yellow.

Head : Black. Frontal tubercles not developed. Eyes and antennae also black. Antennal formula 6-3-4-5 ; unguis about 3 times as long as the base ; 5th antennal segment without secondary rhinaria ; number of rhinaria on 3rd and 4th segment is 13 ranging 7-9 and 3

ranging 0-6, respectively. Rostrum with a yellowish basal half and
blackish distal half ; apical rostral segment with 2 secondary hairs.

FIG. 50: *Aphis nerii* Boyer de Fons. — 1. Fore and hind wings; 2. Siphuncu-
lus; 3. Head (dorsal view) ; 4. Cauda and anal plate (ventral view) ; 5. Antenna;
6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind
tarsus.

Thorax : Prothorax yellowish ; meso- and metathorax black. Wing
venation normal. Leg yellowish except the distal parts of femora,
tibiae and tarsi which are black. First hind tarsal segment with 3 hairs.

Abdomen : Yellow. Two pairs of big abdominal tubercles present
on 1st and 7th abdominal segments ; three other small pairs also usu-
ally present on 2nd to 5th abdominal segments. Siphunculi cylindrical
and black about equal in length to the unguis. Antesiphuncular scle-
rites absent while post-siphuncular sclerites present and conspicuous.

with hairs. Cauda and anal plate black. The former with slight median constriction bearing about 14 hairs.

MATERIAL : 10 specimens on *Nerium oleander*, Feb. 1957, Zeiton (authors' coll.).

Aphis compositae Theobald

1915. *Aphis compositae* Theobald, *Bull. Ent. Res.*, VI, p. 103.

Described from Nairobi from samples collected on an undetermined plant belonging to *Compositae*. HALL (1926) recorded this species in Egypt for the first time on *Solanum nigrum* and *Cestrum pseudoquina (Solanaceae)*. He stated that *A. compositae* Theo. is similar to *A. solanella* Theo., but it differs in colour and in the presence of secondary rhinaria on the 4th antennal segment.

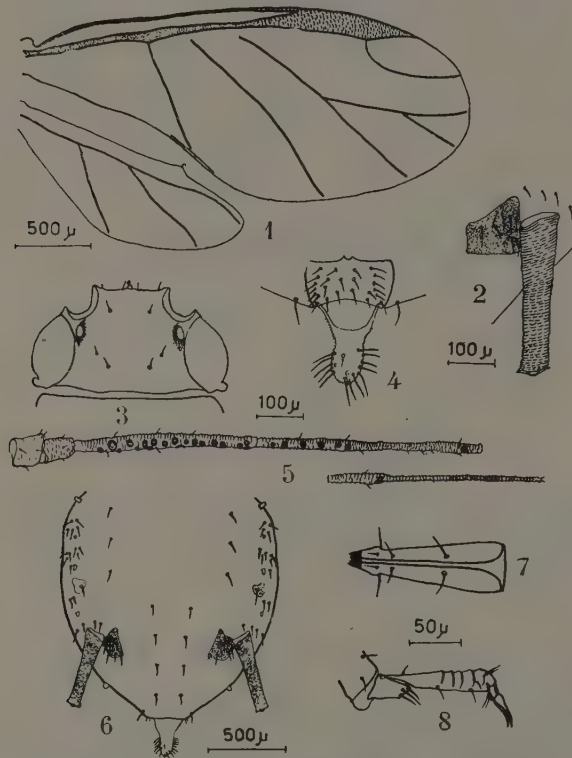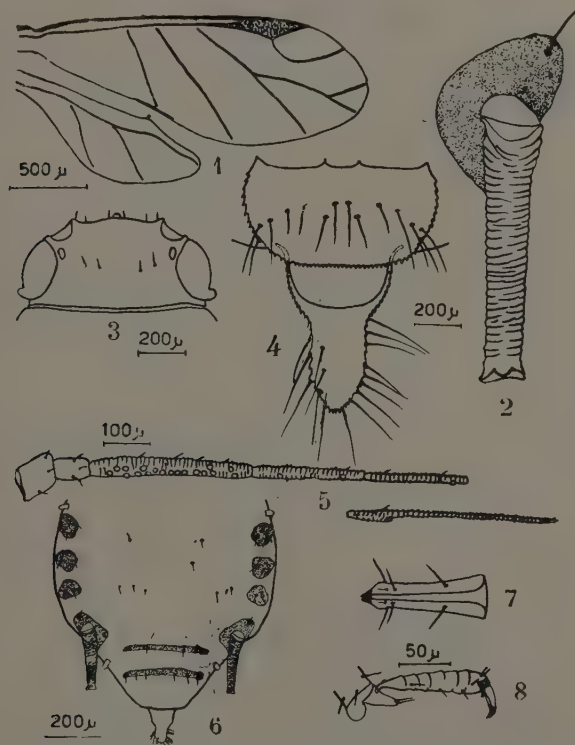FIG. 51: *Aphis compositae* Theo. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Antennae 6-segments, with sub-circular secondary rhinaria ; antennal formula 6-3-4-5 ; unguis about 3.5 times as long as the base ; number of rhinaria on 3rd and 4th antennal segments is 14 ranging 8-21 and 0.1 ranging 0-1, respectively. Apical rostral segment with 2 secondary hairs. Lateral abdominal sclerites present on 1st and 7th abdominal segments within the 1st and 2nd lateral sclerites ; post- and antesiphuncular sclerites present and fused ; 7th and 8th tergites present. Siphunculi cylindrical and shorter in length than the 3rd antennal segment.   Cauda with about 10 hairs.

MATERIAL : 5 specimens on *Solanum nigrum*, March 1921, Giza (coll. Min. Agr.).

Aphis gossypii Glover

1877. *Aphis gossypii* Glover, Report Comm. Agr. Oper. Dep. Washington, p. 36.
1913. *Aphis ligustrella* Theobald, *Bull. Ent. Res.*, IV, p. 313.
1915. *Aphis hederella* Theobald, *Bull. Ent. Res.*, VI, p. 103.
1918. *Aphis bauhiniae* Theobald, *Bull. Ent. Res.*, VIII, p. 273.
1918. *Aphis ficus* Theobald, *Bull. Ent. Res.*, VIII, p. 273.

Described from Egypt by THEOBALD (1918) under the name *A. bauhiniae* collected on *Bauhinia* sp. (WILLCOCKS' collection).   WILLCOCKS (1922) mistook the winter specimens of *A. gossypii* as a distinct species namely *A. malvae* Koch.   THEOBALD (1922) identified this species "*A. gossypii*" on violets at Cairo (WILLCOCKS' collection).   HALL (1926) gave a list of host plants for this species.   He considered *A. malvas* Koch of WILLCOCKS (1922) and *A. bauhiniae* Theo., as synonyms.

EASTOP (1958) stated that *Aphis ficus* Theo. may be a synonym. The writers examined slides of *A. ficus* kept in the Ministry's collection and found them similar to *A. gossypii* in morphology and biometric data.   HALL (1926) stated that specimens of *A. ficus* were inseparable from *A. gossypii* apart from the distinct apple green colour of *A. ficus*. However, the change of colour of body may be due to the change of host plant.   Moreover, the differnce in colour of the body only is not sufficient to separate between two species.

Antennal formula 6-3-4-5.; unguis about 2.2 times as long as the basal part ; number of rhinaria on 3rd segment is ranging 4-10 ; 4th and 5th antennal segments without secondary rhinaria.   Apical rostral segment with 2 scondary hairs.   First hind tarsal segment with 2 hairs.

MATERIAL : 10 specimens on *Hibiscus cannabinus*, Jan. 1957, Mataria (authors' coll.).

FIG. 52: *Aphis gossypii* GLOVER. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Aphis genistae Scopoli

1763. *Aphis genistae* Scopoli, *Ent. Carniolica,* p. 139.

First identified and redescribed in Egypt by THEOBALD (1922) on *Genista* sp. (WILLCOCKS' collection). HALL (1926) examined THEOBALD's paratypes and found them similar to *Aphis craccivora* (= *A. leguminosae*). He collected this species on the same host plant and stated that it differs from THEOBALD's specimens.

Antennal formula 6-3-4-5 ; unguis about 2.2 times as long as the basal part ; number of rhinaria on 3rd and 4th segments is 7 ranging 4-9 and 0.5 ranging 0-1, respectively ; 5th segment without secondary rhinaria. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 2 hairs. Siphunculi cylindrical shorter than 3rd antennal segment. Cauda bearing 4-5 hairs.

MATERIAL : 2 specimens on *Genista* sp., May 1924, Gezireh (coll. Min. Agr.).
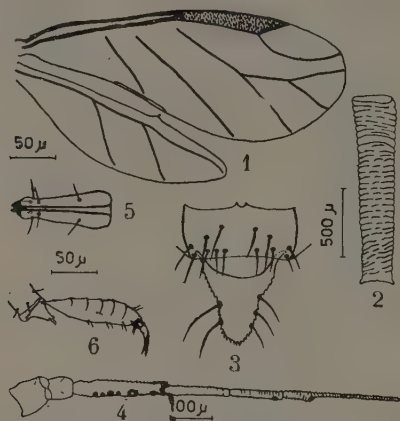
FIG. 53: *Aphis genistae* Scop. — 1. Fore and hind wings; 2. Siphunculus; 3. Cauda and anal plate (ventral view); 4. Antenna; 5. Apical rostral segment (dorsal view); 6. Hind tarsus.

Aphis medicaginis Koch

1854. *Aphis medicaginis* Koch, after Eastop (1958), Colonial Office, Hull Printers Limited, London.

This aphid is known only from Europe, but was mistaken for *A. craccivora* Koch in East Africa as stated by EASTOP (1958). This name has often been applied in the economic literature to members of the *laburni-craccivora* group.

First identified in Egypt by THEOBALD (1915) on *Medicago* sp. (WILLCOCKS' collection). HALL (1926) examined the authentic material of THEOBALD and found them similar to *A. craccivora* (= *leguminosae* Theo.). Specimens collected by HALL from *Medicago* sp. and *Spartum junceum* which were identified as *A. craccivora,* were characterised by shorter siphunculi.

Antennal formula 6-3-4-5 ; unguis about 2.2 times as long as the basal part ; 3rd antennal segment with 5 rhinaria ranging 3-6 and variable in size ; 4th and 5th antennal segments without secondary rhinaria. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 2 hairs. Abdominal tubercles present on 1st and 7th segments. Siphunculi cylindrical and shorter than the 3rd antennal segments. Cauda slightly constricted at the middle bearing about 6 hairs.

MATERIAL : 3 specimens on -*Alhagi maurorum*, May 1935, Abu Rawash and 5 specimens on *Medicago* sp., May 1938, Wadi Battouma-El-Salloum (coll. Min. Agr.).
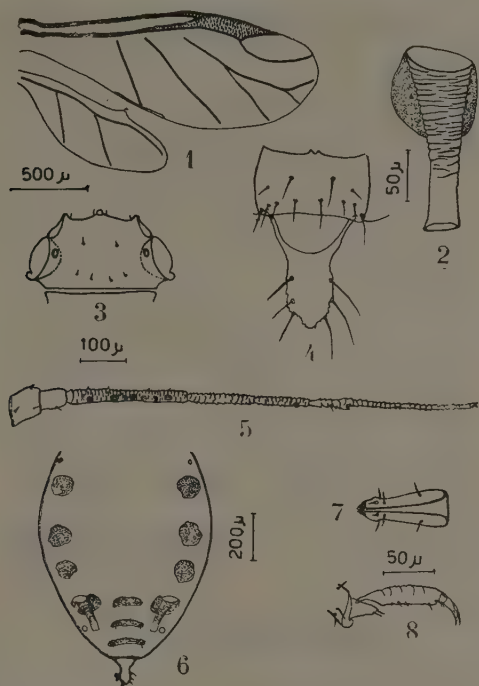

FIG. 54: *Aphis medicaginis* Koch. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Hind tarsus.

Aphis craccivora Koch

1854. *Aphis craccivora* Koch, after Eastop (1958), Colonial Office, Huss Printers Limited, London.
1885. *Aphis robiniae* Macchiati, after Eastop (1958), *ibid.*.
1915. *Aphis leguminosae* Theo., *Bull. Ent. Res.*, VI, p. 103.
1917. *Aphis papilionoearum* Von der Goot, after Eastop (1958), Colonial Office, Hull Printers Limited, London.
1922. *Aphis cistiella* Theo., *Bull. Soc. Roy. Ent. Egypte*, VII, p. 39.

This aphid has often been recorded in East Africa erroneously as *A. laburni* Kalt or *A. medicaginis* Koch. Both *laburni* and *medicaginis* are distinct European species (EASTOP, 1958).

THEOBALD new species were obtained on beans and corn-peas at Giza (WILLCOCKS' collection). HALL (1926) found this pest particularly on leguminous plants and he gave a list of other host plants.

Antennae 6-segmented with sub-circular secondary rhinaria which are different in size ; antennal formula 6-3-(4-5) ; unguis about 1.7 times as long as the basal part ; 3rd antennal segment with 5 rhinaria ranging 4-7 ; 4th and 5th antennal segments without secondary rhinaria. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 2 hairs. Lateral abdominal sclerites present ; abdominal

tubercles present on 1st and 7th segments ; four broken sclerotised bars are present on 2nd to 5th abdominal segments ; ante- and postsiphuncular sclerites present and attached with the 6th tergite ; 7th and 8th
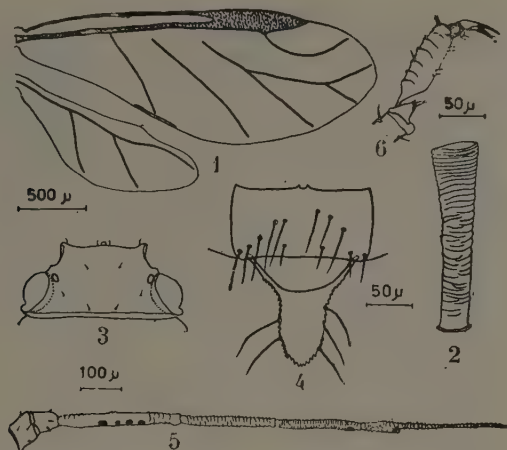

FIG. 55: *Aphis craccivora* Koch. — 1. Fore and hind wings; 2. Siphunculus 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna, 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

tergites well developed. Siphunculus cylindrical and longer than the third antennal segment. Cauda slightly constricted at the middle, bearing 5-7 hairs.

HALL (1926) examined both the types of *A. cistiella* Theo. and specimens collected from *Butea frondosa* (the known host plant for this pest) and found them to be similar to *A. craccivora*. The writers examined slides kept in the Ministry's collection labelled with *A. cis-*

tiella and came to the same conclusion. EASTOP (1958) stated that *A. cistiella* Theo. may be *craccivora* Koch.

MATERIAL : 10 specimens on *Vicia faba*, Jan. 1957, Koubba Palace (authors' coll.).

Aphis punicae Passerini

— *Aphis punicae* Pass., after specimens from British Museum sent by Dr. V. F. Eastop.
1915. *Aphis punicella* Theobald, *Bull. Ent Res.*, VI, p. 103.
1918. *Aphis durantae* Theobald, *Bull. Ent. Res.*, VIII, p. 273.

First recorded and described from Egypt by THEOBALD (1918) under the name of *A. durantae* on *Duranta* sp. (WILLCOCKS' collection). HALL (1926) redescribed it, recorded the presence of the males and stated that they are similar to the alate viviparous females. He also stated that *A. punicella* Theo. is undoubtedly the same as *A. durantae* Theo. The writers examined all specimens of *A. punicella* and *A. durantae* (= *A. punicae*), kept in the Ministry and found them similar. Specimens were also collected from *Durantae* sp. and found to be similar to *A. punicella*.
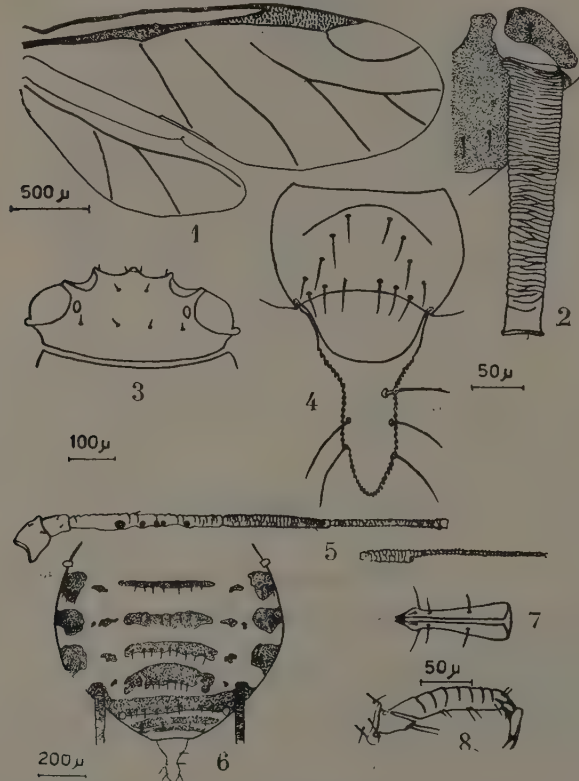

FIG. 56: *Aphis punicae* Pass. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Apical rostral segment (dorsal view); 7. Hind tarsus.

Antennal formula 6-3-(4-5) ; unguis about 2.7 times as long as the basal part ; number of rhinaria on 3rd and 4th antennal segments is 6.5 ranging 6-7, and 1.5 ranging 1-3 ; 5th antennal segment without secondary rhinaria.

MATERIAL : 5 specimens on *Punica granarum*, May 1934, Cairo, and 5 specimens on *Duranta* sp., Nov. 1924, Gezireh (coll. Min. Agr.).

Aphis zizyphi Theobald

1918. *Aphis zizyphi* Theo., *Bull. Ent. Res.*, VIII, p. 237.

Described from Egypt by THEOBALD from samples caught on *Zizyphus spina-christi* (WILLCOCKS' collection). HALL (1926) collected it on the same host plant.

FIG. 57: *Aphis zizyphi* Theo. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Apical rostral segment (dorsal view); 7. Hind tarsus.

Antennal formula 6-3-4-5 ; unguis about 2.5 times as long as the basal part ; number of rhinaria on 3rd and 4th antennal segments is 6 ranging 5-7 and 2 ranging 1-3, respectively ; 5th antennal segment without secondary rhinaria. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 2 hairs. Siphunculi cylindrical showing spiral ornamentation in some specimens which is obscure in others. Cauda with a medium constriction bearing 5-6 hairs.

MATERIAL : 6 specimens on *Zizyphus* sp., May 1919, Gezireh (coll. Min. Agr.).

Aphis acetosella Theobald

1918. *Aphis acetosella* Theo., *Bull. Ent. Res.*, VIII, p. 273.

Described from Egypt by THEOBALD (1918) from *Rumex* sp. and *Papaver* sp. (WILLCOCKS' collection).
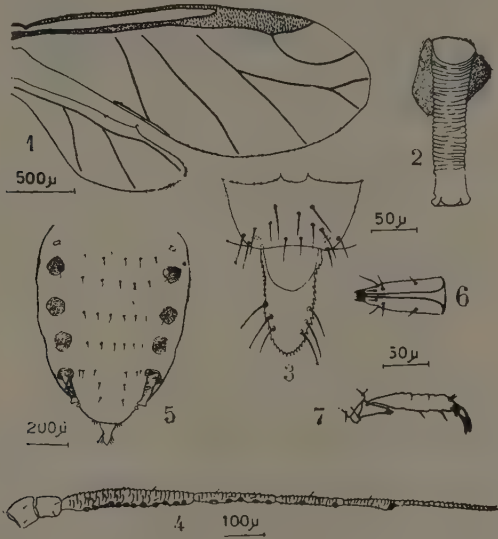
FIG. 58: *Aphis acetosella* Theo. — 1. Fore and hind wings; 2. Siphunculus; 3. Cauda and anal plate (ventral view); 4. Antenna; 5. Abdomen (dorsal view); 6 Apical rostral segment (dorsal view); 7. Hind tarsus.

Antennal formula 6-3-4-5 ; unguis about twice as long as the basal part ; number oh rhinaria on 3rd, 4th and 5th antennal segments is 13 ranging 10-15, 4.5 ranging 3-5 and 1.5 ranging 1-2, respectively. Apical rostrol segment with 2 secondary hairs. First hind tarsal segment with 3 hairs.

MATERIAL : 4 specimens on *Rumex dentatus*, Feb. 1924, Dokki (coll. Min. Agr.).

Aphis mathiolae Theobald

1918. *Aphis mathiolae* Theo., *Bull. Ent. Res.*, VIII, p. 273.

Described from Egypt by THEOBALD (1918) from samples found on Stocks at Gezireh (WILLCOCKS' collection).

Antennal formula 6-3-4-5 ; unguis about 2.5 times as long as the basal part ; number of rhinaria on 3rd, 4th and 5th antennal segments is 13 ranging 11-14, 4 ranging 2-6 and 1.5 ranging 1-2, respectively.
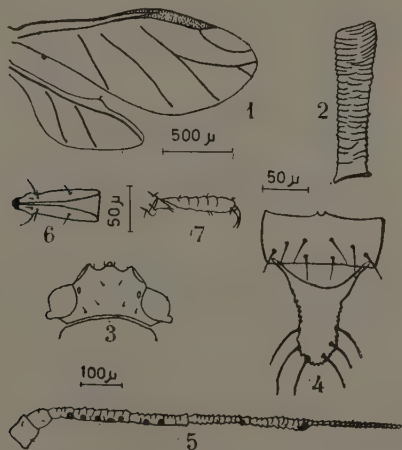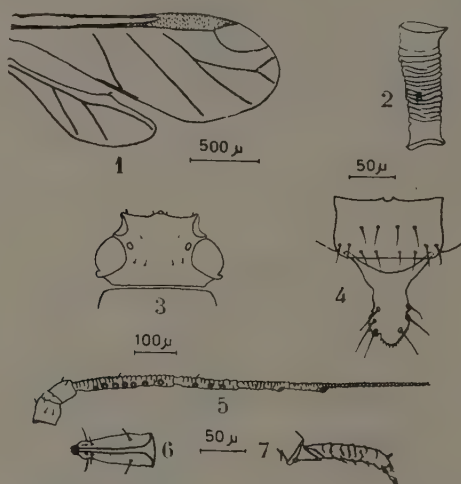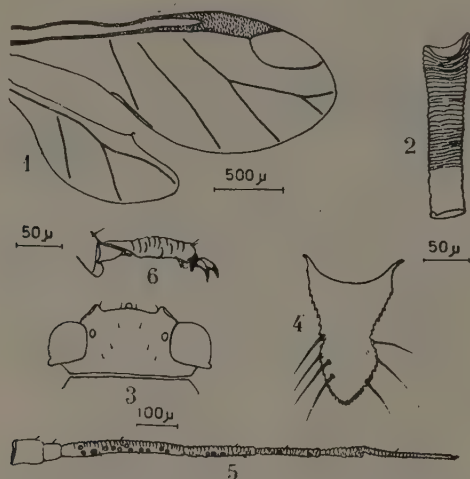

FIG. 59: *Aphis mathiolae Theo.* — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Hind tarsus.

First hind tarsal segment with 2 hairs. Siphunculus cylindrical rather short and thick, about as long as the cauda which bears 6 hairs.

MATERIAL : 5 specimens on Stocks, April 1909, Gezireh (British Museum no. 1930 - 209, THEOBALD's coll.).

Aphis rumicis Linnaeus

1758. *Aphis rumicis* L., Systema Naturae, Edito decima, p. 451.

First recorded in Egypt by WILLCOCKS (1922) on *Papaver* sp. HALL (1926) added *Rumex* sp. as a host plant. DAVIDSON (1921) gave description and drawings of various forms of this species.

Antennal formula 6-3-4-5 ; unguis about 2.5 times as long as the basal part ; number of rhinaria on 3rd, 4th and 5th antennal segment is 12 ranging 10-14, 4 ranging 2-6, and 2 ranging 1-3, respectively. Siphunculi cylindrical, slightly tapering distally about 1-1.5 times as long as the cauda.

It is noteworthy that DAVIDSON (1921) stated that rhinaria on 3rd and 4th antennal segments ranged 12-18 and 0-4, respectively, while no secondary rhinaria present on the 5th as the case in one specimen only of the Ministry's collection.
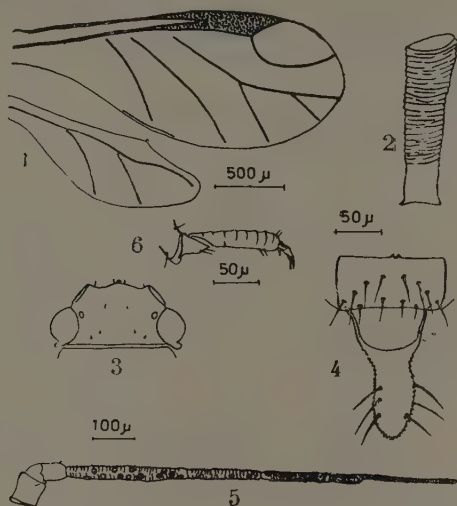
FIG. 60: *Aphis rumicis* L. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Hind tarsus.

MATERIAL : 3 specimens on Docks, March 1909, Gezireh (British Museum Reg. no. 1930 - 204, THEOBALD's coll.

N.B. — The two previous species *A. mathiolae* Theo. and *A. rumicis* L. have shown to be greatly similar to each other. No definite distinguishing characters could be detected in the specimens available to the writers (THEOBALD's paratypes). The writers are inclined at the time being to consider them as host varieties.

Aphis pomi De Geer

1773. *Aphis pomi* De Geer, Mémoires pour servir à l'histoire des insectes, III, p. 53.

First recorded from Egypt by THEOBALD (1922) on *Crataegus* sp. (WILLCOCKS' collection). EASTOP (1958) stated that *A. pomi* has been recorded from several parts of Africa but all material seen by him has proved to be *gossypii* Glover, which was collected from several genera of *Rosaceae* in East Africa.

The writers examined two specimens from THEOBALD'S collection kept in the Ministry and found them typically similar in biometric data and morphology to *A. gossypii*. So the writers are also inclined that they are *gossypii* and not *pomi*.

MATERIAL : One specimen on May tree, 11 April 1916, Heliopolis (Cairo), (THEOBALD'S collection, Ministry of Agric., Cairo).

Aphis laburni Kaltenbach

1843. *Aphis laburni* Kalt., Menographie der Familien der Pflanbenläuse.Aachen, p. 85.

First recorded by THEOBALD (1915) on *Robinia* sp. in 1909 at Giza (WILLCOCKS' collection). HALL (1926) collected material from this host plant and examined THEOBALD'S paratypes and concluded that they are similar to *A. craccivora* Koch (= *A. leguminosae* Theo.). *A. laburni* is a distinct European species and always misrecorded as *A. craccivora* (EASTOP, 1958).

The writers examined specimens kept in the Ministry under the name *A. laburni* and found them similar to *A. craccivora*.

MATERIAL : 10 specimens on *Lens esculenta,* Koose, 19 March 1940 ; and 10 specimens on *Astragalus annularis*, El Shoaba, Salloum, 5 April 1918.

b.   Sub-tribe *Rhopalosiphina*
KEY TO THE GENERA

1(2) 8th abdominal tergum with a supra-caudal process.   Siphunculi very short and vasiform   ... ... *Ceurnavaca*
— 8th abdominal tergum without supra-caudal process.   Siphunculi variable in length and shape 2
2(1) Head with clypeus projecting in front in a semi-globular protuberance   ... ... *Clypeaphis* Sol.
— Head without projecting clypeus 3
3(2) Siphunculus short, about 2/3 as long as the 2nd hind tarsal segment and 4/9 as long as the cauda ... ... *Hyalopterus* Koch
— Siphunculus rather long, equal or longer than the 2nd hind tarsal segment and about 3/5 to 3 times as long as the cauda 4
4(3) Abdomen with several dorsal rows of spinules ... ...
... ... *Rhopalosiphum* Koch
— Abdomen without dorsal rows of spinules 5

5(4) Secondary rhinaria numerous and strongly protruding. Siphunculus short and thick, about 1.5 times as long as their basal width, and little longer than the cauda ... ... *Melanaphis* V. d. Goot

— Secondary rhinaria normal. Siphunculus variable 6

6(5) Siphunculus as long as or shorter than cauda, bearing 10 to 20 hairs ... ... *Longiunguis* V. d. Goot

— Siphunculus longer than the cauda, bearing only 4 to 6 hairs ... ... *Hysteroneura* Davis

Genus CEURNAVAEA

Similar in characters to Genus *Hyalopterus,* but differs in possessing short siphunculi and by the presence of a supra-caudal process on the 8th tergite (similar to that in *Cavariella*). The taxonomic position of this Genus is somewhat doubtful. It is regarded by some as a relative of *Semiaphis* and by others as a degenerate *Hyalopterus.*
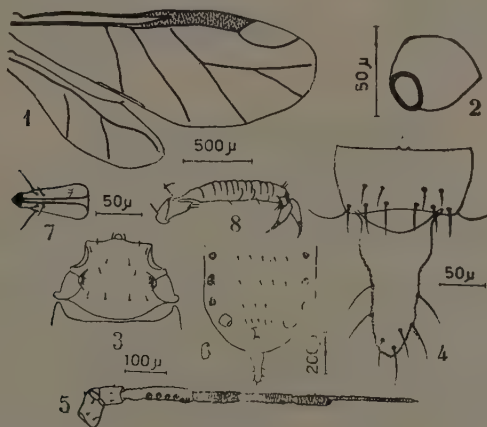
Fig. 61: *Ceurnavaca noxius* (Mordw.). — 1. Fore and hind wings ; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view; 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Dr. Eastop thinks that the latter is more likely to be correct but there is evidence supporting both ideas. The writers could not get the original description of this genus.

Represented in Egypt by one species only, namely *Ceurnavaca noxius* (Mordw.).

Ceurnavaca noxius (Mordwilko)

The writers record this species for the first time in Egypt on the leaves of wheat in March 1957 at Koubba Palace. Specimens were kindly identified by Dr. EASTOP of the British Museum.

Head : Light brown. Frontal tubercles not well developed ; compound eyes black. Antenna, scape and pedicel light brown, flagellum darker except at the base of the 3rd segment where it is lighter in colour. Antennal formula 6-3-(4-5) ; number of rhinaria on 3rd and 4th antennal segments is 6 ranging 4-8 and 2 ranging 1-3, respectively ; 5th segment without secondary rhinaria ; unguis about as long as the basal part. Apical rostral segment without secondary hairs.

Thorax : Brown. Wing venation normal. Legs light brown ; first hind tarsal segment with 2 hairs.

Abdomen : Light green. Lateral sclerites faintly indicated in mounted specimens ; post- and antesiphuncular sclerites absent. Siphunculi very small, vasiform and light green in colour. Cauda light green with a brown anal plate. Supra-caudal process present on the 8th tergite with 2 hairs.

MATERIAL : 10 specimens on wheat, March 1957, Koubba Palace (authors' coll.).

Genus CLYPEAPHIS Soliman

(Type : *Clypeaphis suaedae* Sol.)

1937. *Clypeaphis* Soliman, *The Entomologist's Monthly Magazine,* LXXIII, pp. 181-182.

Frontal tubercles not well developed. Clypeus projecting in front of the head in a semi-globular or cup-shaped with sub-circular rhinaria. Wing venation normal. Siphunculi very short, slightly swollen near the middle. Cauda longer than the siphunculus.

This genus is described from material collected in Egypt.

Clypeaphis suaedae Soliman

1937. *Clypeaphis suaedae* Soliman, *The Entomologist's Monthly Magazine,* LXXIII, pp. 181-182.

Described from Egypt from samples collected on *Suaedae vera (Chenopodiaceae).*

Antennal formula 6-3-5-4 ; unguis about 1.4 times as long as the basal part ; 3rd antennal segment with 5 secondary rhinaria ; 4th seg-

ment without secondary rhinaria. First hind tarsal segment with 2 hairs.

Fig. 62: *Clypeaphis suaedae* Soliman. — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view; 5. Antenna; 6. Hind tarsus.

MATERIAL : One specimen on *Suaeda vera*, March 1935, Bourg el Arab (coll. Min. Agr.).

Genus HYALOPTERUS Koch

(Type : *Aphis pruni* Fabr.)

1854. *Hyalopterus* Koch, Die Pflanz. Aphiden, p. 16.
1917. *Hayhurstia* Del Guercio, *Redia*, XII, p. 208.

Head without distinct antennal tubercles ; antennae 6-segmented with sub-circular rhinaria ; antennal formula 6-3-4-5 or 6-3-(4-5). Wing venation normal ; fore wing with M twice branched ; hind wing with Cu well developed. Abdomen with small lateral tubercles on 1st and 7th segments. Siphunculi very short, slender or less swollen with distinct contriction before apical flange. Cauda long and broad, considerably longer than the siphunculi.

Represented in Egypt by one species, namely *H. pruni* (Geoffry).

Hyalopterus pruni (Geoffry)

1762. *Aphis pruni* Geoffry, Histoire abrégée des Insectes de Paris, Durand, 2 vols., p. 497.
1775. *Aphis arundinis* Fabricius, after Hottes and Frison, 1931, Dept. Reg. Ed., Div. Nat. Hist. Surv., Urbana, Illinois.
1775. *Hyalopterus pruni* (Geoffry), after Hottes and Frison, 1931, *ibid.*

A cosmopolitan pest commonly known as mealy plum aphid. It is found in Europe, North America and Africa infesting plums and related fruits. The proper specific name to use for this species is *pruni* Goffry. FABRICIUS (1775) listed this species under two names, *A arundinis* and *A. pruni* (referring to GEOFFRY) the former having page priority and hence causing its use by recent writer (HOTTES and FRISON, 1931). HOTTES in 1954 has asked the International Commission of Zoological Nomenclature to use its plenary powers to validate this name *"H. pruni"* (EASTOP, 1958).

First recorded in Egypt by WILLCOCKS (1916) on apricot, peach trees, *Phragmites communis* and *Arundo donax*. HALL (1926) found that specimens from *Arundo donax* and *Phragmites communis* show consistently many more rhinaria on the antennal segments of the alatae (3rd, 24-30 ; 4th, 1-2) than is found on specimens from the other host plants (3rd, 11-18 ; 4th, 0-3). HALL also recorded *Buddleia madagascariensis* as a new host plant. No precise description, however, was given to this species in Egypt.
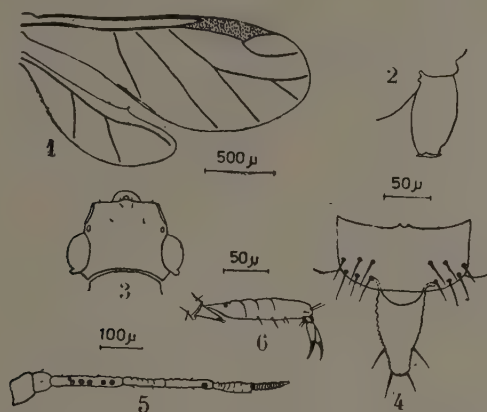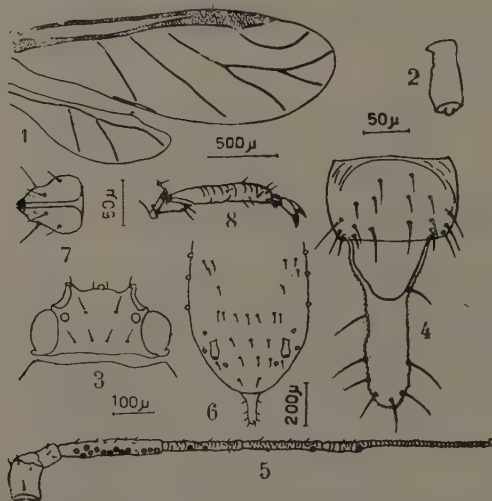

FIG. 63: *Hyalopterus pruni* (Geoffroy). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

General colour ; head and thorax brown, abdomen green. Body covered with powdery wax.

Head : Heavy brown, covered with powdery wax. Eyes red to brown. Antennae 6-segmented ; scape and pedicel brown and translucent ; 3rd, 4th and 5th segments whitish and translucent with brown parts ; 6th segment brown ; antennal formula 6-3-4-5 ; unguis about 3 times as long as the basal part ; 3rd and 4th antennal segments with 13 rhinaria ranging 10-16 and 1 ranging 0-2, respectively. Apical rostral segment with 2 secondary hairs.

Thorax : Covered with powdery wax. Acrotergum yellowish. Thorax light brown dorsally but green ventrally. Wing venation normal. Wings membranous. Sc, R and R_s green ; the rest of veins whitish in colour ; stigma with a green appearance in colour. Leg : coxa green ; femur yellowish green with a brown distal half ; tibia yellowish green with a brown distal part (1/5) ; tarsi brown ; first hind tarsal segment with 2 hairs. The leg covered in some parts with fine powdery wax.

Abdomen : Covered with powdery wax, oblong in shape and green coloured. 1st and 7th segments bear always a pair of lateral tubercles each, which may be occasionally present on the 2nd to the 6th segments. Siphunculi short and green. Cauda very short, conspicious and dark green. Anal plate brown.

Alate males collected at light trap were identified by Dr. EASTOP of the British Museum. They are similar to the alate viviparous females except in the following :

1. The 6th antennal segment is shorter although the antennal formula is the same (6-3-4-5).

2. Rhinaria present on 4th and 5th segments. Their numbers are comparatively higher being 31 ranging 25-35, 18 ranging 12-24 and 13 ranging 7-19 on 3rd, 4th and 5th antennal segments, respectively.

3. Unguis is shorter.

4. A median abdominal dorsal sclerite present on each of the 1st to 6th segments. A large oblong sclerite present on the 7th segment.

MALE GENETALIA (Fig. 2 ; 1) : Claspers short conical slender lobes about 67 μ in length, ranging 55-77 μ. Aedeagus, tubular with a broad base, moderately long about 103 μ in length, ranging 88-110 μ.

MATERIAL : 10 specimens of alate viviparous females on peach, April, 1957, Fayoum ; 10 specimens of alate males caught on the light trap, Dec. 1957 (authors' coll.).

Genus RHOPALOSIPHUM Koch

(Type : *Aphis nympheae* L.)

1854. *Rhopalosiphum* Koch, Die. Pflanz. Aphiden, p. 23.
1860. *Siphocoryne* Passerini, Gli Afidi, p. 28.
1882. *Rhopalosiphon* Scudder, Nomenclator Zoologicus.
1915. *Siphonaphis* Van der Goot, Beiträge zur Kennt. d. Holl. Blattläuse, p. 238.
1918. *Stephensonia* Das, *Mem. Ind. Mus.,* VI, p. 175.

The above list of synonyms shows that this genus has passed through a rather long state of instability. At last, it was recognised again by its original name *"Rhopalosiphum* Koch" as is stated by BACKER (1920).

Head without prominent frontal tubercles. Antennae 5 to 6-segmented with the usual sub-circular rhinaria. M of fore wing once or twice branched ; hind wing with 2 oblique veins. Abdomen characterised by the polygonal pattern of the spinules on the dorsum. Siphunculi moderately long, cylindrical, slightly or much swollen near their distal extremities. Cauda elongate, shorter than siphunculi and with a comparatively narrow base bearing 4 to 9 hairs. Abdomen with or without very weakly developed dorsal pigmentation. Males usually alate.

Represented in Egypt by four species only, namely *R. rufiabdominalis* (Sasaki), *R. maidis* (Fitch), *R. nympheae* (L.) and *R. padi* (L.).

KEY TO THE SPECIES

1(2) Antennae 5 or 6-segmented. Body clothed with long hairs. 8th tergite with 4 to 8 hairs ...   .   *rufiabdominalis* Sasaki

— Antennae 6-segmented. Body clothed with short hairs. 8th tergite with only 2 hairs 2

2(1) Unguis less than 3 times as long as the base. Apical rostral segment usually shorter than 2nd hind tarsal segment   ... ...
... ...   *maidis* Fitch

— Unguis more than 3 times as long as the base. Apical rostral segment usually as long as or longer than 2nd hind tarsal segment . 3

3(2) Siphunculi distinctly swollen near the apex. Unguis about 3.8 times as long as the base ... ...   *nympheae* L.

— Siphunculi not clavate. Unguis about five times as long as the base ... ... *padi* L.

Rhopalosiphum rufiabdominalis (Sasaki)

1915. *Aphis splendens* Theobald, *Bull. Ent. Res.*, VI, p. 103.
1915. *Cerosipha californica* Essig, after Hille Ris Lambers, 1937. Results of the Norwegian Scientific Expedition to Tristan Da Cunha, No. 34, p. 1.
1915. *Cerosipha subterranea* Mason, after Hille Ris Lambers, *ibid.*
1915. *Rhopalosiphum rufiabdominalis* (Sasaki), after Hille Ris Lambers, *ibid.*

First recorded in Egypt by THEOBALD (1915) on the roots of wheat, barley and rice. HALL (1926) found it later on *Arundo* sp. and Orobanche growing on tobacco roots.

Most of the writers' specimens were characterised by the 5-segmented antennae. One specimen, however, had 6-segmented antennae and some of the specimens showed assimetry, one antenna being 5-segmented while the other is 6-segmented.
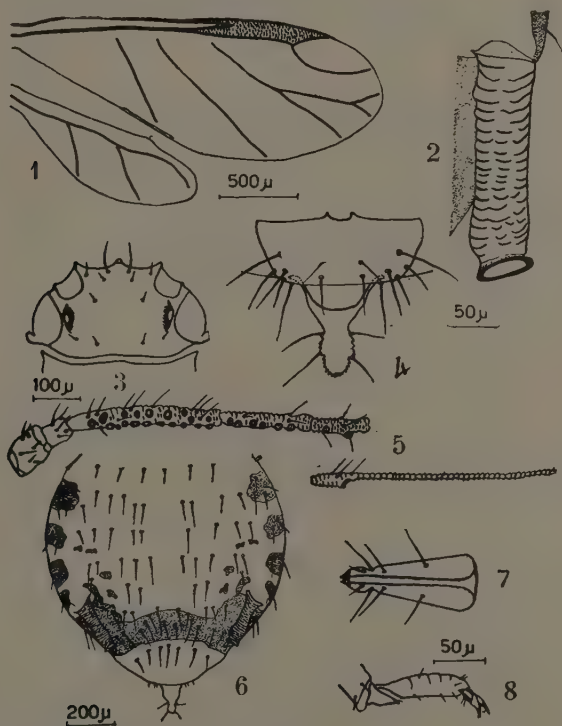

FIG. 64: *Rhopalosiphum rufiabdominalis* (Sasaki). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Body covered with long hairs. Antennal formula 6-3-4-5 ; unguis about five times as long as the base ; mean number of rhinaria on 3rd, 4th and 5th antennal segments is 18, 6 and 3, respectively. In case of 5-segmented antennae, the rhinaria are confined to the 3rd and 4th segments only, their number being from 10 to 22 on the 3rd and from 1 to 5 on the 4th. Abdominal lateral tubercles present only on 1st and 7th segments ; lateral sclerites well developed with long hairs ; intersegmental pleural sclerites "Muskelplatten" present. Siphunculi imbricated with distinct flange. Postsiphuncular sclerites well developed and fused in some specimens with the 7th abdominal tergite. Cauda distinctly constricted about the middle bearing 4 hairs. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 2 hairs.

MATERIAL : 10 specimens caught on the light trap, March 1958, Koubba Palace (authors' coll.).

Rhopalosiphum maidis (Fitch)

1855. *Aphis maidis* Fitch, *Trans. New York State Agr. Soc.*, XV, p. 550.
1901. *Aphis adusta* Zehntner, after Hassan, M. S., 1957, *Bull. Soc. Ent. Egypte,* XLI, p. 200.
1904. *Aphis sorghi* Theob., 1st Rep. Wellcome Res. Labs., pp. 43-45.
1915. *Aphis africana* Theob., *Bull. Ent. Res.,* IV, p. 313.
1915. *Rhopalosiphum maidis* (Fitch), after Stroyan, 1950, *Trans. R. Ent. Soc. Lond.,* CI (3), p. 120.

It is a cosmopolitan species commonly known as the Corn Leaf Aphid. First recorded in Egypt by THEOBALD (1915) from specimens received from WILLCOCKS. WILLCOCKS (1922) recorded it again from wheat, barley, maize and sugar sorghum or broom corn. HALL (1926), added millet and *Panicum* sp. as other host plants. He also confirmed that *Aphis sorghi* is a synonym to *R. maidis.* EASTOP (1958) stated that *Aphis africana* is another synonym. HASSAN (1957) studied the biology of this species in Egypt under the name of *Aphis maidis.* He was not aware of the fact of the change of the name of the genus from *Aphis* to *Rhopalosiphum* (STROYAN, 1950).

Antennal formula 6-3-4-5 ; unguis about 2.3 times as long as the basal part. Number of rhinaria on 3rd, 4th and 5th antennal segment ranges from 17-27, 4-10 and 1-6, respectively. Apical rostral segment with 2 secondary rhinaria. First hind tarsal segment with 2 hairs. Lateral abdominal sclerites present ; post- and antesiphuncular sclerites also present.

ALATE MALES: Specimens recorded for the first time in Egypt by a light trap, which may denote the occurrence of sexual reproduction. It was previously believed that reproduction in this species is only parthenogenitical. The morphology and biometrics of the males are
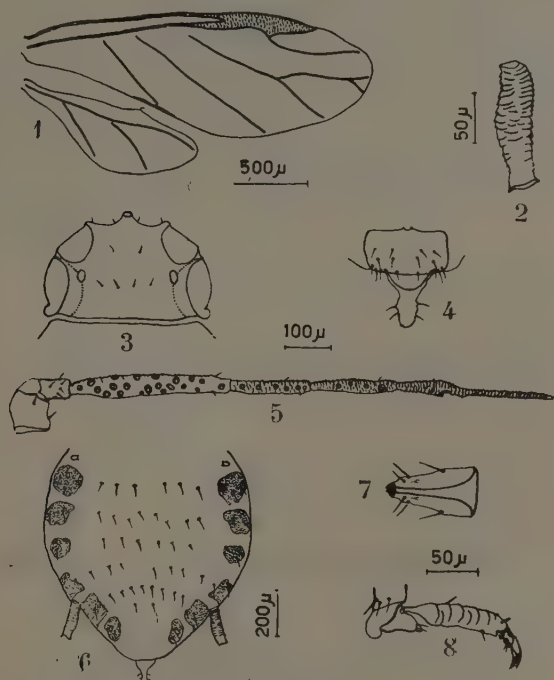
FIG. 65: *Rhopalosiphum maidis* (Fitch). — 1 Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

nearly similar to the viviparous females except in the clearly higher number of rhinaria on the 3rd, 4th and 5th antennal segments which ranges from 46-61, 26-33 and 11-24, respectively. Male genitalia ; claspers short conical, slender lobes about 48 μ in length, ranging from 44-55 μ. Aedeagus, tubular with a broad base not long, about 73 μ in length ranging from 66-77 μ.

MATERIAL : 10 specimens of alate viviparous females on wheat, March 1957, Koubba Palace ; 3 specimens of alate males caught on the light trap, Nov. 1957 and Feb. 1958 (authors' coll.).

Rhopalosiphum nympheae (Linnaeus)

1761. *Aphis nympeae* L., Fauna Svecica, Editio Altera, Auctior, *Stockholm,* p. 260.
1794. *Aphis plantarum aquaticum* Fabricius, Syst., IV, p. 214.
1794. *Rhopalosiphum nympheae* Koch, after Theobald, 1915, *Bull. Ent. Res.,* VI, p. 103.
1794. *Rhopalosiphum olismae* Kóch, after Theobald, 1915, *ibid.*
1794. *Rhopalosiphum najadum* Koch, after Theobald, 1915, *ibid.*
1801. *Aphis butami* Schrank, Fauna Boica, II, p. 117.
1908. *Aphis aquaticus* Jackson, *Ohio Nat.,* VIII, p. 243.
1915. *Siphocoryne nympheae* Theobald, *Bull. Ent. Res.,* VI, p. 103.

A cosmopolitan species. It attacks aquatic plants. It has been recorded in Egypt by THEOBALD (1915) and HALL (1926) on *Nympheae* sp.
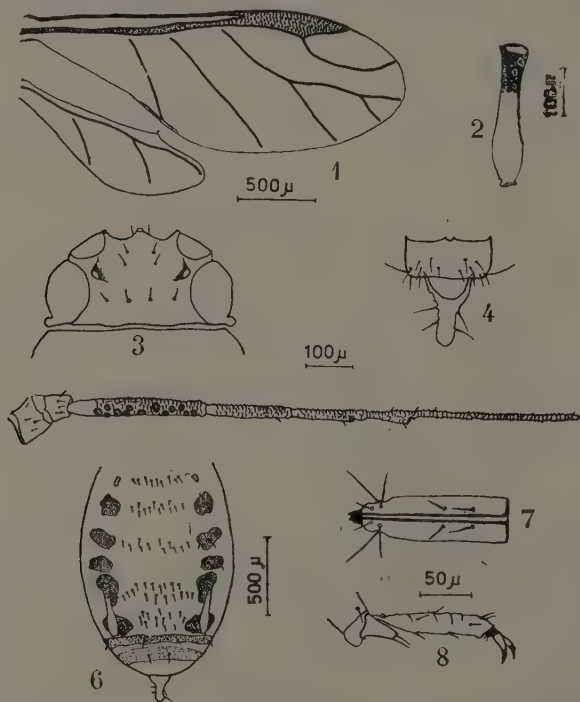
FIG. 66: *Rhopalosiphum nympheae* (L.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view; 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Antennal formula 6-3-4-5; unguis about 3.8 times as long as the basal part; rhinaria on 3rd and 4th antennal segments ranging from 13-24 and 0-6, respectively. Apical rostral segment with 4 secondary hairs. Thoracic tubercles present. First tarsal segment of hind tarsus with 2 hairs; only one rhinarium present on the base of the second

tarsal segment. Abdomen with distinct lateral sclerites ; 1st and 7th lateral abdominal tubercles present ; the latter wihin a lateral sclerite. Siphunculi swollen at the apical half, with a distinct flange. Ante- and post-siphuncular sclerites present and fused together.

MATERIAL : 10 specimens caught on the light trap, April 1958, Koubba Palace (authors' coll.).

Rhopalosiphum padi (Linnaeus)

1758. *Aphis padi* L., after Eastop, 1958, Colonial Office, Hull Printers, London.
1854. *Aphis prunifoliae* Fitch, *Trans. New York State Agr. Soc.*, XIV, p. 826.
1862. *Aphis avenae* Fabricius, after Eastop, 1958, Colonial Office, Hull Printers, London.
1931. *Rhopalosiphum prunifoliae,* Hottes and Frison, Dept. Reg. and Ed. Div. Natural History Survey, Urbana, Illinois.
1931. *Rhopalosiphum padi* (L.), after Eastop, 1958, Colonial Office, Hull Printers, London.

FIG. 67: *Rhopalosiphum padi* (L.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

A migrating species which over-winters on plums and migrates during summer to several other plants (THEOBALD, 1927, and HILLE RIS LAMBERS 1955).

The writers had the chance to record this species for the first time in Egypt. Specimens were collected together with *Rhopalosiphum maidis* from wheat at Koubba Palace, 1957. It was also found attacking *Btunia* sp., *Nicotiana* sp., and *Chrysanthemum* sp. in the same locality.

Antennal formula 6-3-4-5 ; rhinaria on 3rd, 4th and 5th antennal segments ranging from 14-27 ; 3-10 and 1-4, respectively. Apical rostral segment with 2 secondary hairs. First hind tarsal segment with 2 hairs. Abdominal lateral sclerites well developed ; intersegmental pleural sclerites "Muskelplatten" present ; ante- and post-siphuncular sclerites present, the latter being larger. Siphunculi imbricated, swollen distally with a distinct flange. Cauda constricted at the middle, with 4 hairs.

This species confuses with *Rhopalosiphum rufiabdominalis* (6-segmented antennae) to a great extent. It differs only in :

1. Body covered with short hairs.

2. Sclerotisation of the tergum of the 7th abdominal segment is absent.

MATERIAL : 10 specimens on wheat, March 1957, Koubba Palace (authors' coll.).

Genus MELANAPHIS Van der Goot

(Type : *Aphis bambusae* Fullaway)

1917. *Melanaphis* Van der Goot, after Eastop, 1958, Colonial Office, Hull Printers Limited, London.
1937. *Masraphis* Soliman, *Ent. Mon. Mag.*, LXXIII, pp. 181-182.

Head with frontal tubercles small and not spinulose. Antennae 6-segmented and bearing numerous strongly protuberant rhinaria on 3rd to 5th segments ; unguis about 4.75 to 5.5 times as long as the basal part. Wing venation normal. Lateral abdominal tubercles very small, always present on 1st and 7th segments. Siphunculi short and thick, about 1.5 times as long as their basal width, and little longer than the cauda. Cauda more or less elongate with basal constriction bearing only 5 hairs, and 1/10 or less as long as the body. Very similar to Genus *Longiunguis* except for the few caudal hairs and the strongly protuberant rhinaria of alatae.

Represented in Egypt by one species only, namely *M. phyllostachia* (Soliman).

Melanaphis phyllostachia (Soliman)

1937. *Masraphis phyllostachia* Soliman, *Ent. Mon. Mag.*, LXXIII, pp. 181-182.
1937. *Melanaphis phyllostachia* (Soliman), after Eastop, 1958, Colonial Office, Hull Printers Limited, London.

Described from Egypt from samples living on *Phyllostachus mytis* and *Phragmites* sp. (Gramineae).
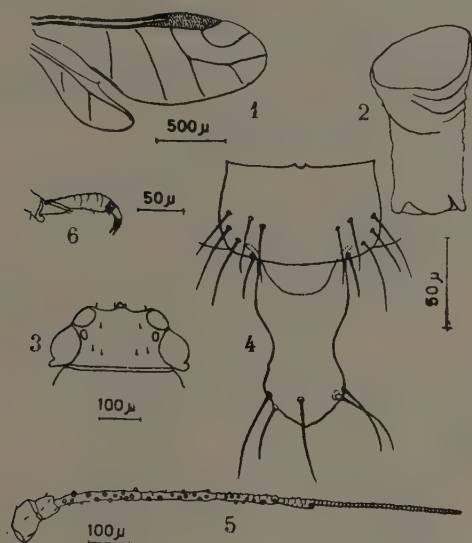
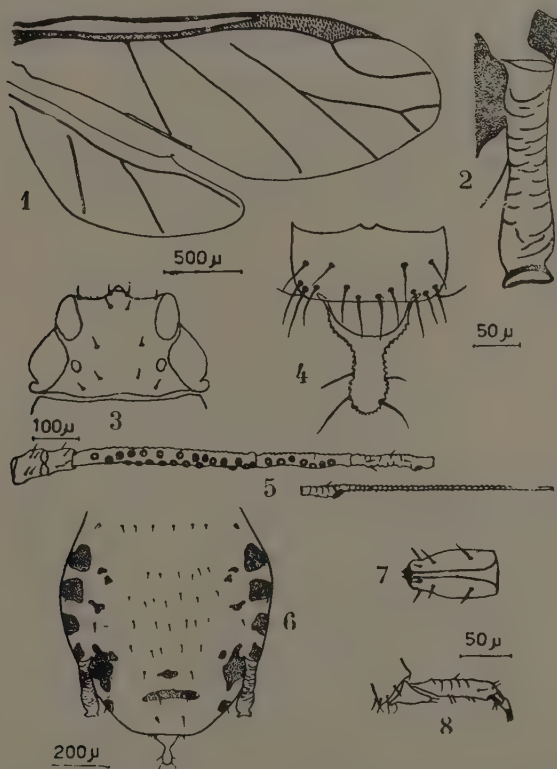FIG. 68: *Melanaphis phyllostachia* (Soliman). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view; 5. Antenna; 6. Hind tarsus.

Antennae 6-segmented with strongly protruding rhinaria ; antennal formula is 6-3-5-4 ; unguis about 5.5 times as long as the basal part ; number of rhinaria on 3rd, 4th and 5th antennal segments is 19 ranging 17-20, 12 ranging 10-13, and 9 ranging 7-11, respectively. First hind tarsal segment with 2 hairs. Siphunculi short and tapering slightly longer than the cauda which is constricted about the middle with 6 hairs.

MATERIAL : 3 specimens on *Phyllostachus mytis*, Nov. 1933, Orman (Giza) (coll. Min. Agric.).

Genus LONGIUNGUIS Van der Goot

(Type : Aphis sacchari Zehntner)

1916. *Longiunguis* Van der Goot, Zur Kenntniss der Blattläuse Java's, p. 112.

Head without prominent frontal tubercles. Antennae 6-segmented and armed with subcircular rhinaria. Wing venation normal. Lateral abdominal tubercles always very small and present on 1st and 7th abdominal segments. Siphunculi rather short and thin, but much thicker than the tarsi. Cauda more or less elongate and usually with a slight basal constriction, bearing 10 to 20 hairs.

Represented in Egypt by one species only, namely *Longiunguis donacis* (Pass.).

Longiunguis donacis (Passerini)

1861. *Longiunguis donacis* (Pass.), after Eastop, 1958, Colonial Office, Hull Printers Limited, London.

1918. *Hyalopterus insignis* Theobald, *Bull. Ent. Res.*, VIII, p. 273.

FIG. 69: *Longiunguis donacis* (Pass.). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view; 5. Antenna; 6. Abdomen (dorsal view); 7. Apical rostral segment (dorsal view); 8. Hind tarsus.

Recorded by THEOBALD (1918) from Egypt under the name of *Hyalopterus insignis* (WILLCOCKS' coll.). HALL (1926) found it on reed grass or buffalo grass *"Arundo donax"*.

Antennal formula 6-3-(4-5) ; unguis about 1.6 times as long as the basal part ; number of rhinaria on 3rd antennal segment is 79 ranging 5-13 ; 4th and 5th antennal segments without secondary rhinaria. Apical rostral segment without secondary hairs. First hind tarsal segment with 2 hairs. Lateral abdominal tubercles always present on 1st and 7th segments, but absent or present on inbetween segments. Abdomen without dorsal pigmentation ; 8th tergite usually with 4 hairs. Siphunculi rather short. Ante- and post-siphuncular sclerites absent. Cauda rather elongate with a slight median constriction bearing about 12 hairs.

MATERIAL : 10 specimens caught on the light trap, March 1958, Koubba Palace (authors' coll.).

Genus HYSTERONEURA Davis

(Type : *Aphis steriae* Thos.)

1919. *Hysteroneura* Davis, *Can. Ent.,* LI, p. 228.
1919. *Heteroneura* Davis, *Can. Ent.,* LI, p. 263.

Head without prominent frontal tubercles. Antennae 6-segmented with subcircular rhinaria. Wing venation reduced. Siphunculi somewhat tapering or subcylindrical, longer than the cauda which is constricted about the middle and bears 4 to 6 hairs only.

KEY TO THE SUB-GENERA

1(2) 8th tergite with 4 or more hairs. Cauda black ... ...
... ... *Praschizaphis* Hille Ris Lambers
— 8th tergite with only 2 hairs 2
2(1) Cauda long and pale, with a distinct basal constriction. Unguis about six times as long as the basal part and about twice as long as the siphunculus ... ... *Hysteroneura* s. str.
— Cauda normal and often dark. If pale then siphunculi usually pale also. Unguis rarely twice as long as the siphunculus ... ...
... ... *Schizaphis* Börner
Represented in Egypt by the Sub-Genus *Schizaphis* only.

Sub-Genus SCIZAPHIS Börner

(Type : *Aphis graminum* Rondani)

1931. *Schizaphis* Börner, *Mitteilungen über Blattläuse* Anz. Schädlingsk, VII, p. 8.

Cauda normal and often dark, when pale then siphunculi pale also. Unguis variable in length but rarely twice as long as the siphunculus. Fore wing with M once branched ; hind wing with Cu and A present. 8th tergite with 2 hairs only.

Represented in Egypt by three species, namely *S. cyperi* Van der Goot, *S. graminum* (Rond.) and *S. minuta* Van der Goot.

KEY TO THE SPECIES

1(2) Unguis more than 5 times as long as the basal part ; 4th antennal segment with secondary rhinaria ... ... *cyperi* Van der Goot
— Unguis less than 4 times as long as the basal part ; 4th antennal segment with or without secondary rhinaria 2
2(1) Siphunculi cylindrical, rather long. 4th antennal segment without rhinaria ... ... *graminum* Rondani
— Siphunculi truncate, short with distinct flange. 4th antennal segment rarely without rhinaria ... ... *minuta* Van der Goot

Hysteroneura (Scizaphis) cyperi (Van der Goot)

1917. *Toxoptera cyperi* Van der Goot, after Eastop, 1958, Colonial Office, Hull Printers Limited, London.
1922. *Aphis acori* Theobald, *Bull. Soc. Roy. Ent. Egypte,* VII, p. 39.
1922. *Acaudus calami* Theobald, *Bull. Soc. Roy. Ent. Egypte,* VII, p. 39.
1926. *Toxoptera acori* Hall, Tech. and Sc. Serv., Min. Agric. Egypt, Bull. 68, pp. 1-62.
1926. *Hysteroneura (S.) cyperi* (Van der Goot), after Eastop, 1958, Colonial Office, Hull Printers Limited, London.

First recorded and described from Egypt by THEOBALD (1922) under the name of *Aphis acori* (WILLCOCKS' collection) from sedge *"Cyperus longus"*. In the same paper he recorded the presence of an apterous form (WILLCOCKS' collection) on the same host plant, under the name *Acaudus calami,* which is now considered as a synonym (EASTOP, 1958). HALL (1926) found this species common on sedge and placed it, doubtfully under the Genus *Toxoptera* depending on the character that M

of fore wing is once branched, a character which is not mainly consi-
dered in the recent taxonomy of this genus.

FIG. 70: *Hysteroneura (Schizaphis) cyperi* (Van der Goot). — 1. Fore and
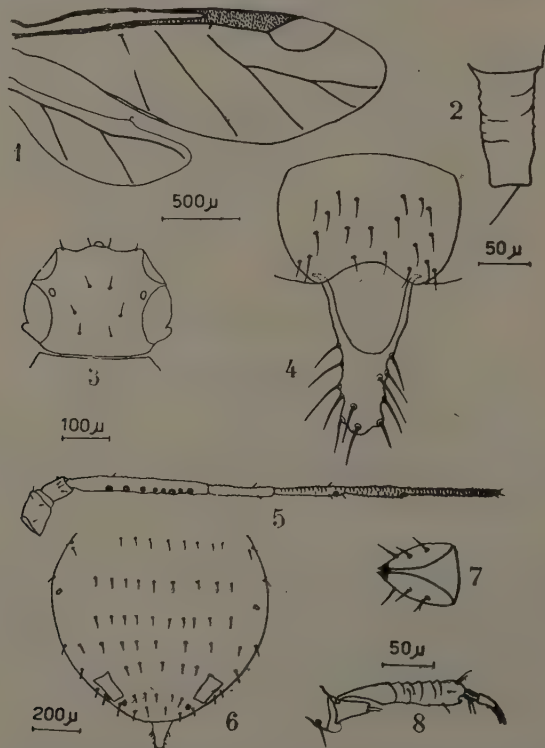hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate
(ventral view); 5. Antenna; 6. Abdomen (dorsal view); Apical rostral segment
(dorsal view); 8. Hind tarsus.

Antennal formula 6-3-4-5; unguis about 6 times as long as the
basal part; number of rhinaria on 3rd, 4th and 5th antennal segments
is 12 ranging 10-15, 5 ranging 3-7 and 1.5 ranging 1-2, respectively.
Apical rostral segment with 2 secondary hairs. First hind tarsal seg-
ment with 2 hairs. Lateral abdominal sclerites present. Siphunculi
long, cylindrical and black. Cauda black with 5 hairs. Antesiphun-
cular sclerite present.

MATERIAL : 3 specimens caught on the light trap on 1957, Koubba
Palace (authors' coll.).

Hysteroneura (Schizaphis) graminum (Rondani)

1847. *Aphis graminum* Rondani, *Nuovi annali delle scienze naturali,* Bologna,
     Ser. 3, VI, p. 10.
1947. *Toxoptera graminum* (Rondani), after Eastop, 1958, Colonial Office, Hull
     Printers Limited, London
1947. *Hysteroneura (S.) graminum* (Rondani), after Eastop, 1958, *ibid.*

First recorded in Egypt by WILLCOCKS (1922). He gave rice, millet
and *Cynodon dactylon* as host plants.
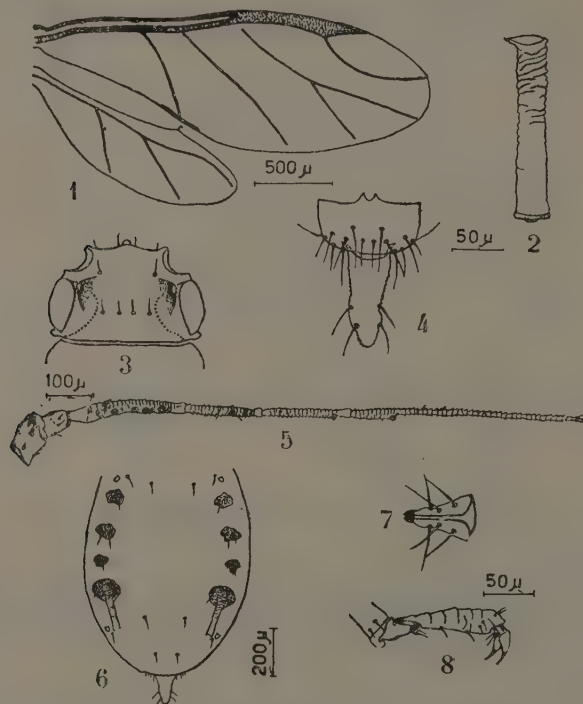
FIG. 71: *Hysteroneura (Schizaphis) graminum* (Rondani). — 1. Fore and
hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate
(ventral view); 5. Antenna; 6. Abdomen (dorsal view); Apical rostral segment
(dorsal view); 8. Hind tarsus.

Antennal formula 6-3-4-5; unguis about 3.4 times as long as the
basal part; number of rhinaria on the 3rd antennal segment 6 ranging
5-7; 4th and 5th antennal segments without secondary rhinaria. Apical
rostral segment with 2 secondary hairs. First hind tarsal segment
with 2 hairs. Lateral abdominal sclerites present but small; ante- and

post-siphuncular sclerites fused and encircling the base of the siphunculi.

MATERIAL : 10 specimens on wheat, March 1957, Koubba Palace (authors' coll.).

Hysteroneura (Schizaphis) minuta (Van der Goot)

1917. *Hysteroneura (S.) minuta* (Van der Goot), after Eastop, 1958, Colonial Office, Hull Printers Limited, London.

The writers record this species for the first time in Egypt. Specimens collected by the light trap, were kindly identified by Dr. EASTOP. Its known host plant in East Africa is *Cyperus amabilis* (EASTOP, 1958).
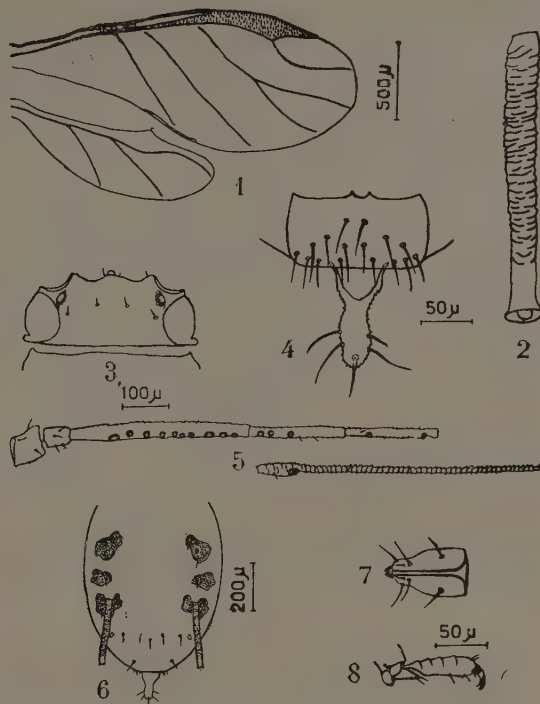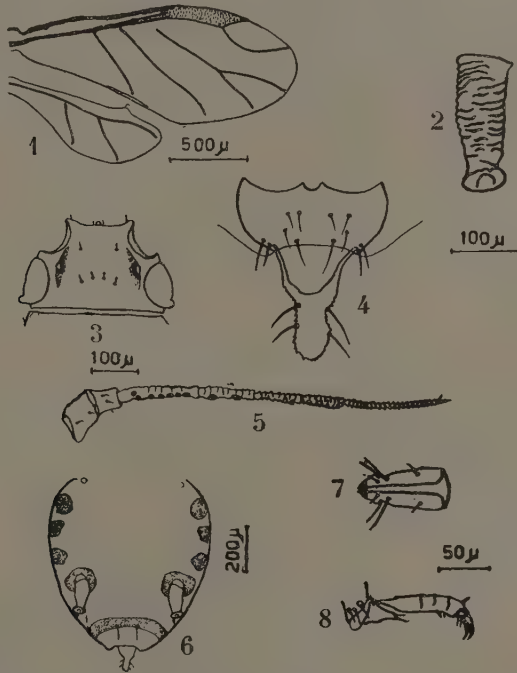

FIG. 72: *Hysteroneura (Schizaphis) minuta* (Van der Goot). — 1. Fore and hind wings; 2. Siphunculus; 3. Head (dorsal view); 4. Cauda and anal plate (ventral view); 5. Antenna; 6. Abdomen (dorsal view); Apical rostral segment (dorsal view); 8. Hind tarsus.

Body clearly small. Antennal formula 6-3-4-5 ; unguis about 3.2 times as long as the basal part ; number of rhinaria on 3rd, 4th and 5th segments is 6 ranging 5·7, 2 ranging 0-3 and 1 ranging 1-2. Apical rostral segment, rather long with 2 secondary hairs. · First hind tarsal

segment with 2 hairs. Lateral abdominal sclerites present ; ante- and post-siphuncular sclerites present, fused and encircling the base of the siphunculi ; 8th tergite with 2 hairs only.

MATERIAL : 10 specimens caught on the light trap, Feb. 1958, Koubba Palace (authors' coll.).

ACKNOWLEDGMENT

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DEUX NOUVEAUX AMMOPHILES DE LA FAUNE EGYPTIENNE

par ANASTASE ALFIERI

Ammophila (s. s.) mitlaensis, nov. spec.

FEMELLE : Tête noire, finement ponctuée ; épistome festonné, avec une pointe très apparente de chaque côté et échancré au milieu de son bord antérieur, recouvert d'un feutrage argenté et de poils blancs épars. Mandibules rembrunies avec l'extrémité noire, tri-dentées. Antennes noires. Thorax noir, dessus glabre, contours velus de poils grisâtres ; collare éparsément ponctué ; mésonotum ponctué-chagriné et portant deux lignes latérales élevées ; scutellum densément chagriné ; métanotum fortement chagriné et strié. Ecaillettes lisses, brillantes, rembrunies. Pattes noires ; tibias, tarses et ongles fortement rembrunis. Ailes sub-hyalines, légèrement enfumées, surtout à l'extrémité, les nervures brun-rouge. Pétiole rouge, très allongé (5-6 mm.), le premier segment légèrement plus long que le second, qui est sensiblement renflé postérieurement ; troisième segment de l'abdomen, rouge ; quatrième segment rouge avec sa partie postérieure noire formant une tache triangulaire dont la pointe atteint le sommet du segment ; segments suivants entièrement noirs. — Longueur, 17 et 19 mm. ; envergure, 18 et 21 mm.

HABITAT : 2 femelles, holotype et paratype (coll. ALFIERI), le premier provenant du Wadi Mitla (Sinaï), 21.iii.1937, le second du Wadi Mitla (Sinaï), 8.v.1938.

MALE : Inconnu.
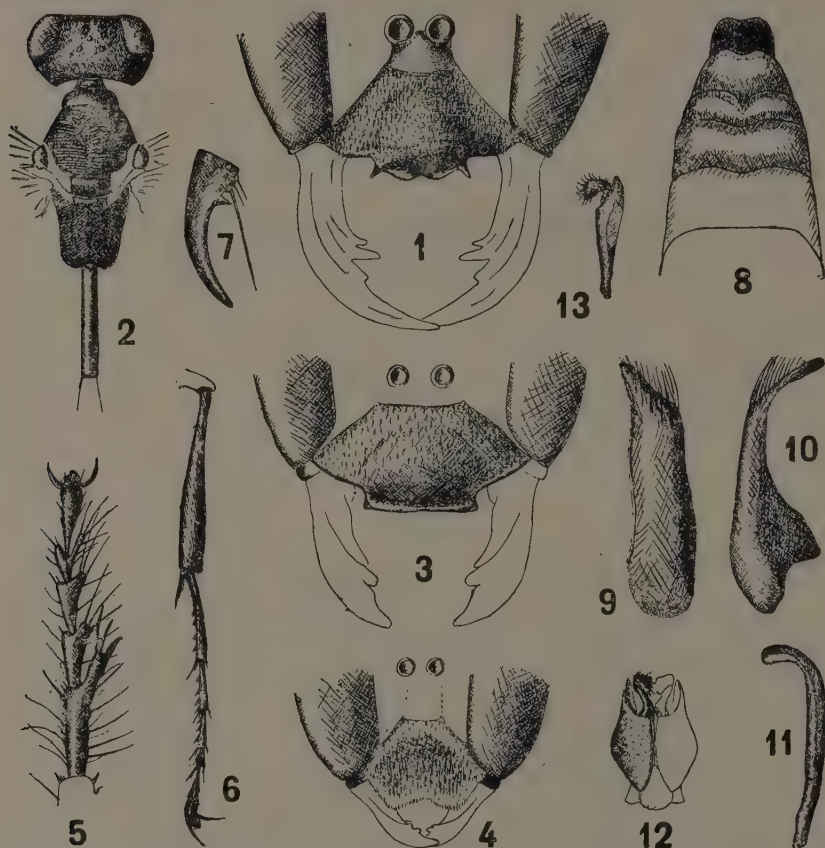
FIG. 1: *Ammophila* (s. s.) *mitlaensis,* nov. spec.: épistome de la femelle. — FIGS. 2-13: *Ammophila* (*Eremochares*) *mitlaensis,* nov. spec.: (2) Aspect et sculpture du mâle; (3) Epistome de la femelle; (4) Epistome du mâle; (5) Peigne du tarse antérieur de la femelle; (6) Tibia et tarse postérieurs de la femelle; (7) Ongle du tarse postérieur de la femelle; (8) Plaque anale du mâle; (9-13) Différentes pièces de l'armature génitale du mâle.

Ammophila (Eremochares) gibba, nov. spec.

FEMELLE : Tête noire, légèrement ponctuée, avec des poils blancs, plus longs et arqués sur la partie postérieure ; épistome presque tronqué droit, à bordure antérieure rembrunie, recouvert d'un épais feutrage argenté. Mandibules rembrunies avec l'extrémité noire, bi-dentées. Antennes noires. Thorax noir, éparsement velu, poils blancs ; collare presque glabre ; mésonotum et scutellum plus ou moins rugueux ou chagrinés ; métanotum pourvu en dessus de stries obliquement incurvées en direction des côtés latéraux. Ecaillettes lisses, brillantes,

rouges. Pattes noires ; tibias, tarses et ongles fortement rembrunis. Ailes sub-hyalines, très légèrement enfumées, les nervures rougeâtres. Premier segment du pétiole noir, d'un quart plus long que le second qui est conique, rouge avec l'extrémité noire ; troisième et quatrième segments abdominaux rouges ; cinquième segment rouge avec le dessus noir ; segments suivant entièrement noirs. — Longueur, 20-22 mm. ; envergure, 22-24 mm.

MALE : Coloration et pilosité comme chez la femelle, aspect général plus grêle. Mandibules tri-dentées. Epistome sensiblement échancré au milieu de son bord antérieur qui n'est pas rembruni ; mésonotum transversalement strié et portant deux gibbosités élevées. Premier segment du pétiole d'un tiers plus long que le second. — Longueur, 17 mm. ; envergure, 17 mm.

HABITAT : 2 femelles (holotype et paratype, coll. ALFIERI), provenant du Wadi Aideb (Gebel Elba), 4.ii.1923 ; 1 mâle (allotype, coll. ALFIERI), originaire du Wadi Rabdet (Gebel Elba), 21.i.1933.

THE EXTERNAL MORPHOLOGY
OF TWO CERAMBYCID LARVAE

[*Coleoptera*]

(with 9 Text-Figures)

by S. M. HAMMAD, PH.D. and SHAFIK I. HASSAN, B.SC. Agric.,
Faculty of Agriculture, University of Alexandria.

The two larvae described here are those of *Xystrocera globosa* Oliv. and *Stromatium fulvum* Villers. Adults and larvae of the former were found boring on Lebbek trees (*Albizzia lebbek*). On the other hand, adults and larvae of *Stromatium fulvum* were found on *Casuarina equisetifolia* and *Eucalyptus* trees. The exit holes of *X. globosa* are about 1.5 cm. high and 7 mm. wide, while those of *S. fulvum* are about 9 mm. high and 6 mm. wide.

Mature larvae were obtained from Nozha Gardens (Alexandria) during February 1960. They were treated in 10% caustic soda solution for about 2 weeks, washed in water and then transferred to 70% alcohol. In the latter, the head-capsules were separated from their bodies which were cleared from all the different internal systems. The head-capsules as well as the cuticle of the two larvae were stained in 5% borax carmine, transferred to 90% alcohol and then to absolute alcohol. Clearing of the specimens occurred in cedar wood oil and finally they were mounted on slides in Canada balsam. All figures were drawn by using the square eye-piece.

Xystrocera globosa Oliv.

The body of the mature larvae is whitish in colour, sub-cylindrical, elongate and tapering in form. It is about 4-5 cm. long and about 7 mm. wide (in the widest part, i.e. the prothorax). Abdomen 10-segmented, the last segment carrying the Y-shaped anal aperture as shown in Figure 2 C. Cuticle with sclerites as shown in Figures 1 C and 2 A, B.

There are one pair of spiracles on the mesothorax and eight pairs on the first eight abdominal segments. The spiracles (Fig. 2 D) are of the annular bilabiate type. The three pairs of thoracic legs are very small in size, each leg is 4-segmented and provided with setae and sensillae as shown in Figure 1 E; the apical segment is devoid of any setae and terminates with a short and fine claw.
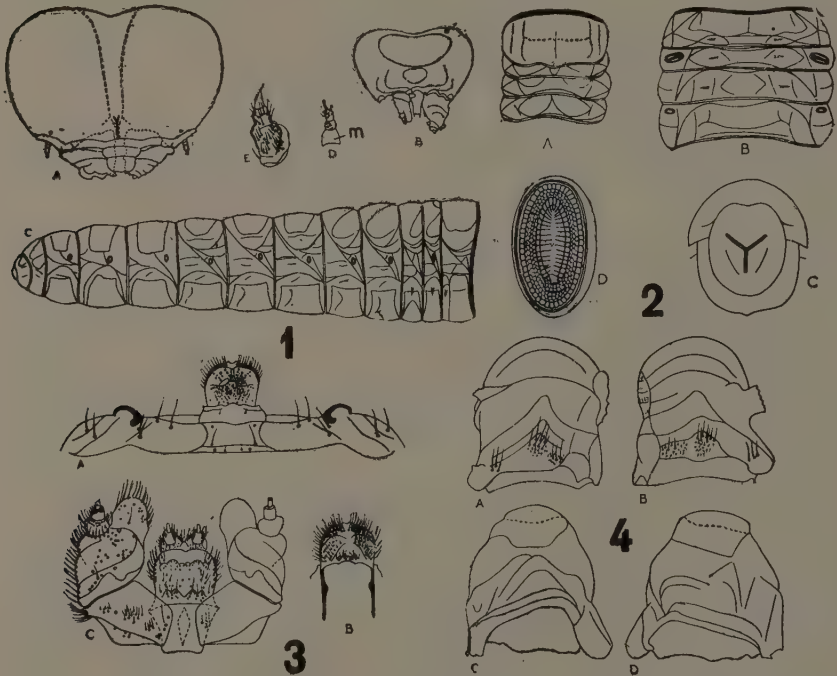
Fig. 1: *Xystrocera globosa* (A, head-capsule, dorsal view; B, same, ventral view; C, cuticle, lateral view; D, antenna (M, basal membrane); E, leg, inner view). — Fig. 2: *Xystrocera globosa* (A, terga of thorax and 1st abdominal segment; B, sterna of same; C, posterior view of last abdominal segment; D, spiracle). — Fig. 3: *Xystrocera globosa* (A, labrum, clypeus and epistoma, dorsal view; B, epipharynx; C, labium and maxillae, external view). — Fig. 4: *Xystrocera globosa* (A, left mandible, dorsal view; C, same, ventral view; B, right mandible, dorsal view; D, same, ventral view).

The head-capsule is well-defined, somewhat depressed dorso-ventrally, and deeply retracted inside the prothorax. Its anterior portion is more deeply pigmented and sclerotized than the posterior portion. The epistomal ridge is conspicuous (Fig. 3 A). The sides of the head are rounded and diverge towards the posterior portion; head with

sclerites and sutures as shown in Figure 1 A, B.   Ventral side of head
with two holes and is bridged by a broad hypostoma with a gula along
the meson on top of the hypostoma (Fig. 1 B).   There are one pair of
distinct ocelli on each side of the head-capsule, the upper ocellus is
much larger than the lower one.   Antenna relatively very small, with
three segments, and has a large basal membrane in which the seg-
ments retract (Fig. 1 D).

Distinct labrum and clypeus are present with setae and sensillae
as shown in Figure 3 A ; clypeus with one small seta on each side.
Epipharynx with setae and sensillae as shown in Figure 3 B ; it is pro-
vided with two relatively long rods extending to nearly one and half
times long as that of the labrum.

Each mandible with gouge-like cutting edge which passes into the
lower and upper edges in a regular curve (Fig. 4).   Dorsally, each
mandible bears three groups of different-sized setae as shown in
Figure 4 A, B.

The maxilla consists of a distinct cardo, stipes, 3-segmented pulpus
with a conspicuous palpifer, and a mala which is fused with the stipes.
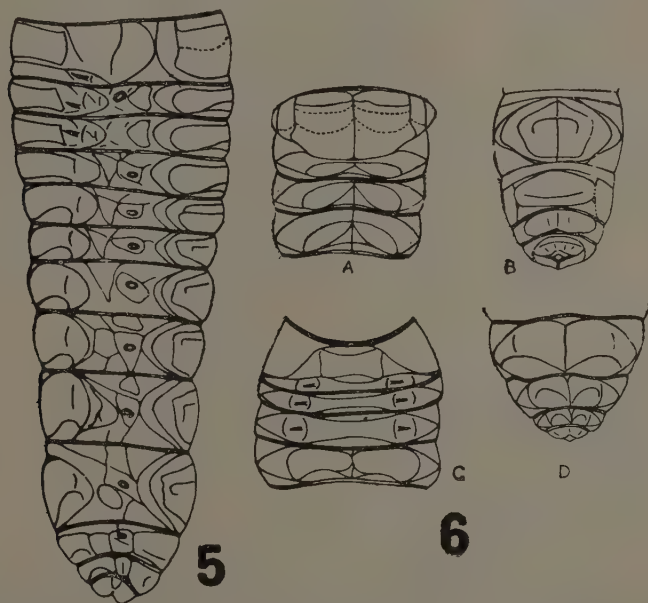
FIG.5: *Stromatium fulvum* (Cuticle, lateral view). — FIG. 6: *Stromatium
fulvum* (A, terga of thorax and 1st. abdominal segment; B, terga of 7th.-10th.
abdominal segments; C, sterna of thorax and 1st. abdominal segment; D, sterna
of 7th.-10th. abdominal segments).

.   The labium is attached to the gula and consists of a submentum, mentum, ligula and a pair of 2-segmented palpi ; each palpus bears a distinct palpiger. Maxillae and labium with setae and sensillae as shown in Figure 3 C.

Stromatium fulvum Villers

The body of the mature larva is whitish in colour, sub-cylindrical, and elongate. It is about 2.5 cm. long and about 5 mm. wide (in the widest part, i.e. the prothorax). Abdomen 10-segmented ; the last seg-
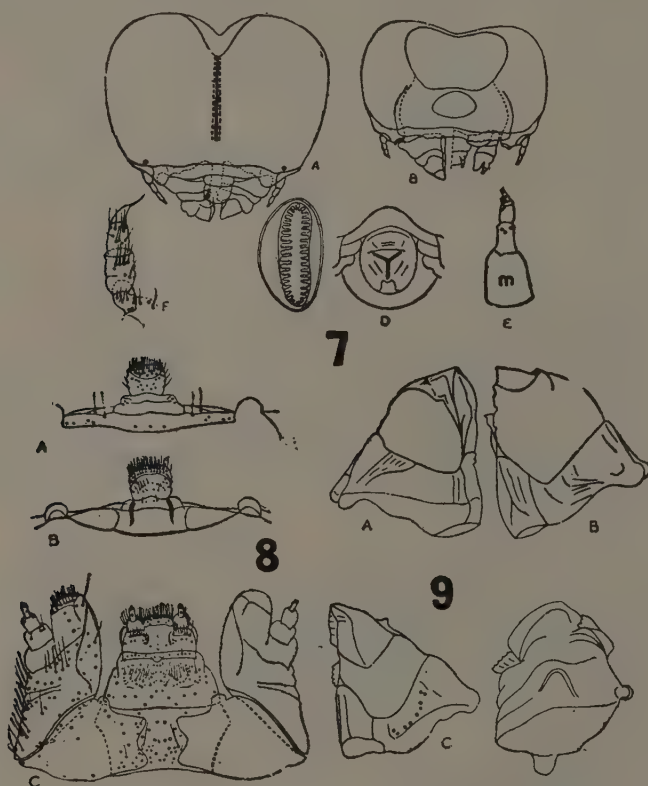
FIG. 7: *Stromatium fulvum* (A, head-capsule, dorsal view; B, same, ventral view; C, spiracle; D, last abdominal segment, posterior view; E, antenna (m, basal membrane); F, leg, inner view). — FIG. 8: *Stromatium fulvum* (A, labrum, clypeus and epistoma, dorsal view; B, epipharynx; C, labium and maxillae, external view). — FIG. 9: *Stromatium fulvum* (A, left mandible, dorsal view; C, same, ventral view; B, right mandible, dorsal view; D, same, ventral view).

ment with a Y-shaped anal aperture at its tip (Fig. 7 D). Body with shape and sclerites as shown in Figures 5 and 6. The chitinous ring at the anterior margin of the prothoracic segment is present. The spiracles are annular and bilabiate in shape ; they are also situated on the mesothorax and the first eight abdominal segments (Fig. 7 C). Each leg is 4-segmented and with the apical segment devoid of any setae or sensillae and carrying a single claw (Fig. 7 F).

The head is well-defined, somewhat depressed dorso-ventrally, and deeply retracted inside the prothorax. The sides of the head are rounded and diverge towards its posterior portion ; head with sclerites and sutures as in Figure 7 A, B. Also the anterior portion of the head is very dark in colour while it is pale and whitish posteriorly. The epistomal ridge is obvious. Ventrally, head with two holes and bridged by the hypostoma which is covered completely by the broad gular sclerite. There is only one small ocellus on each side of the head-capsule. The antenna is 3-segmented with a large basal membrane (Fig. 7 E) and has a few setae.

The labrum and clypeus are distinct, labrum with setae and sen-sillae as shown in Figure 8 A. Epipharynx with setae and sensillae as shown in Figure 8 B ; it is provided by two stout short rods which are of about the same length as those of the labrum. On each side, the clypeus has 3 sensillae dorsally while ventrally it has one seta as well as one sensilla.

The mandibles are of sharp and oblique cutting edges (Fig. 9) ; dorsally, the mandibles have no setae or sensillae while ventrally they are provided with some sensillae (Fig. 9 C).

Maxillae and labium with setae and sensillae as shown in Fig. 9 C.

SUMMARY

Xystrocera globosa and *Stromatium fulvum* larvae were found to be attacking the stems and branches of certain wood trees in Nozha Gardens in Alexandria. The external morphology of the head-capsule, cuticle, and mouth-parts of the mature larva of each of these two pests is given in detail.

ACKNOWLEDGMENTS

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CONTRIBUTIONS TO THE KNOWLEDGE OF SOME WOOD-BORERS FROM EGYPT

[*Coleoptera*]

by S. M. HAMMAD, PH.D., F.R.E.S.,

Faculty of Agriculture, University of Alexandria.

It is a well-known policy of the United Arabic Republic to increase its own sources of wood for supplying its needs of timber and paper industry. Therefore, much efforts are paid to reforestrate large areas of land in the Northern as well as in the Southern regions of the R.A.U. This has made the author to give special attention to study the wood-boring insects which attacks many kinds of shade trees, shrubs, or fruit trees in Egypt.

In the present work nine species belonging to the families Scolytidae, Bostrychidae and Curculionidae are dealt with. They were all found in great numbers and were causing considerable damage to their host plants.

Scolytid bettles live just beneath the bark of standing or felled trees feeding upon the cambium and adjacent tissues and leaving characteristic engravings upon both the inner surface of the bark and the wood. Boring dust is pushed out of the tunnels and clings to the bark or accumulates about the base of the trees. The feeding of these beetles ends by killing the trees. The exit holes are always circular in shape. The larval tunnels may or may not be full of wood dust.

Beetles belonging to the family Bostrychidae make cylindrical burrows in felled timber or dried wood, and occasionally attack unhealthy standing trees. Partly or recently seasoned wood is also attacked. The larval tunnels are filled with fine, flour-like wood dust. The exit holes are always cylindrical in shape.

Members of the subfamily Cossoninae (Curculionidae) attack hard woods as well as soft woods. Usually, sapwood is preferred but probably heart wood under suitable conditions is also attacked. However,

they prefer seasoned wood which is more or less decayed and they occur in structural timbers but not in furniture. The borings of the larvae are filled with fine wood dust and under heavy attack, the wood may be reduced to powder. The exit holes are irregular in shape.

The material studied in this work has been all collected at the Alexandria University Agricultural Experimental Farm during the months of August, September and October.

It is here worthy mentioning those pioneers who contributed to the knowledge of the wood-borers of Egypt, i.e. CLAINPANAIN (1909), ALFIERI (1909, 1910, 1914, 1916, 1929), ADAIR (1917), WILLCOCKS (1922), THÉRY (1929, 1936, 1937), BARBIER (1943), WILTSHIRE (1949), HASSAN (1956), DESCARPENTRIES (1954), HAMMAD (1955, 1956), and AZMY (1958).

Scolytidae

Hypothenemus eruditus Westw.

Attacks dead, weakened, or even healthy branches of citrus trees, *Ficus* sp., *Poinciana* sp., *Acacia* sp., *Hibiscus* sp. and *Pittosporum* sp. It makes engravings between both the inner surface of the bark and the wood. The exit holes are about $\frac{1}{3}$-$\frac{1}{2}$ mm. in diameter.

DUFFY (1953) refers to this beetle found in an old book imported to England from Egypt and also from specimens found in Cocos imported to England from Ceylon. Adult, about 1-1.2 mm. long, dark brown in colour ; legs yellowish brown. Elytra, thorax and abdomen bearing numerous squamiform, triangular setae. Thorax finely punctured while elytra strongly punctured. Almost anterior half of pronotum with fine teeth. Antennal funicle 3-segmented in male, 4-segmented in female ; segment 1 longer than following ones together. Club with septum between segments 1 and 2. Tibia with 6 externo-lateral and apical stout setae and spines.

Cryphalus (Stephanoderes) vulgaris Schauf.

Attacks dead, weakened, or even healthy branches of fig trees (*Ficus caryca*) and makes engravings between the inner surface of the bark and the wood. The exit holes are about 0.75-1 mm. in diameter.

Adult dark brown in colour, measuring about 1.7 mm. long. Thorax, elytra and abdomen covered with numerous squamiform, whitish and triangular setae. Thorax finely punctured while elytra strongly punctured. Anterior end of pronotum covered with numerous fine teeth. Antenna with funicle 4-segmented ; segment 1 nearly as

long as all following segments. Club with septum between segments 1 and 2. . Tibia with 6 externo-lateral and apical stout setae and spines.

Hypoborus ficus Erichson.

Is found together with *Hypothenemus? aspericollis* on dead weakened or even perfectly healthy branches of fig trees but in larger numbers. It makes engravings between the inner surface of the bark and the wood. The exit holes are about ½ mm. in diameter.

Adult, about 1.4 mm. long, dark brown in colour ; legs, antennae, sides of elytra and pronotum light brown. Thorax, elytra and abdomen covered with squamiform, triangular and whitish setae. Thorax finely punctured and elytra strongly punctured. Cephalic margin of elytra crenulated and slightly raised. Antennal funicle 4-segmented ; segment 1 about one and half times as long as second segment. Club with three septa between segments 1, 2, 3 and 4. Tibia with 8 externo-lateral and apical stout setae and spines.

Scolytus aegyptiacus Pic.

It attacks dead, weakened or healthy branches of peach and apricot trees. Its engravings between the inner surface of the bark and the wood are characteristic. The exit holes are about 1 mm. in diameter.

Adult about 2-2.5 mm. long. It is pitchy in colour ; antennae, anterior margin of pronotum, almost posterior half of elytra, tibia and tarsi reddish in colour. Thorax, elytra and abdomen covered with squamiform, long and whitish setae. Thorax and elytra strongly punctured. Funicle of antenna 6-segmented ; 1 segment as long as 2. Club with pyramid-shaped septum between segments 1 and 2. Tibia with 3 apical spines, 1 large and 2 much smaller.

Phloeosinus bicolor Brullé.

Attacks perfectly healthy trees of *Cypressus macrocarpa*. Attack starts always on the main trunk of the tree in the axis of the branches which fade in colour, then turn yellow and finalley fall down. The exit holes appear at the tips of the branch ends which are left on the tree. The tunnels on the main trunk are local and do not travel far to the wood itself. It was noticed that the tunnels which are empty of any stage of this insect were always full of dark-coloured and sticky sap oozed from the tunnels.

Adult about 2.5 mm. long. It is pitchy in colour with antennae light red. Thorax, elytra and abdomen covered with numerous squamiform, triangular and whitish setae. Elytra with rows of teeth.

Thorax finely punctured and elytra strongly punctured. Cephalic (anterior) margin of elytra finely crenulated and slightly raised. Funicle 4-segmented ; 1 segment nearly one and half times as long as 2. Club with septum between 1 and 2. Tibia with 13 externo-lateral and apical stout setaé and spines.

Bostrychidae

Scobicia chevrieri Villa.

It attacks weakened as well as healthy branches of fig trees. The larva bores in the cambium of the branch circularly and thus causing the death of the branch. The exit holes are about 2 mm. in diameter.

Adult about 3 mm. long. Head and thorax light brown and most of elytra pitchy ; cephalic ends of latter yellowish in colour. Head provided dorsally with fairly long whitish setae taking the shape of a semi-circle. Anterior half of pronotum provided with numerous teeth. Elytra confusedly punctured and anterior margins of same finely crenulated and slightly raised.

Sinoxylon ceratoniae Luc.

As in *Scobicia chevrieri*, it attacks weakened or perfectly healthy branches of fig trees. The larvae bore long, single, closed and oblique burrows inside the wood, different from those of *S. chevrieri*. The exit holes are about 3-4 mm. in diameter.

Adult about 5 mm. long. Head, thorax and end of elytra pitchy, and anterior sides of latter yellowish-brown in colour. Anterior half of pronotum provided with numerous teeth. Elytra with strongly punctured striae and provided with a pointed strong spine near apices.

Curculionidae

Mesites (Rhopalomesites) cunipes Boh.

This weevil of the sub-family Cossoninae was infesting heavily a felled tree of *Salix* sp. The whole tree was full of irregular tunnels and nearly reduced to powder.

Adult, about 5 mm. long, dark-brown in colour ; head slightly darker than rest of body. Antennae inserted near base of rostrum in male and front of middle in female. Thorax slightly elongate and not as strongly punctured as elytra. Latter parallel-sided for nearly front two-thirds with broadest parts near base. Rostrum elongate, narrow

and more or less parallel-sided but dilated near insertion of antennae. Antenna geniculate, funicle 6-segmented and club 4-segmented.

SUMMARY

Six scolytid beetles are recorded from Alexandria (University Agricultural Experimental Farm). These are *Hypothenemus eruditis* Westw., *Hypothenemus ?aspericollis* Wall., *Hypoborus ficus* Eirchson, *Cryphalus* sp., *Scolytus aegyptiacus* Pic, and *Phloeosinus bicolor* Brullé. As to the two Bostrychid borers, they are *Scobicia chevrieri* Villa and *Sinoxylon ceratoniae* Luc. A single weevil, *Mesites (Rhopalomesites) cunipes* Boh. was also recorded. The host plants of all these recorded species as well as their characteristic engravings are described.

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STUDIES ON THE BIOLOGY AND ECOLOGY
OF Pentodon bispinosus Kust. IN EGYPT

I.   THE ADULT STAGE

[Coleoptera :   Scarabaeidae-Dynastinae]

(with 2 Text-Figures)

by MAHMOUD HAFEZ, M.SC., PH.D., F.R.E.S.,

*Head of the Department of Entomology, Faculty of Science,
Cairo University,*

and SADEK I. BISHARA, M.SC.,
Senior Entomologist, Ministry of Agriculture, Egypt.

CONTENTS

I.   INTRODUCTION

In Egypt, the sub-family Dynastinae comprises several representatives more or less injurious to agriculture, namely *Pentodon bispinosus* Küst., *Temnorrhynchus baal* Reiche, *Phyllognathus excavatus* Forst., *Heteronychus licas* Klug and *Heteronychus parumpunctatus* Burm. These insects attack several field crops such as maize and sugar-cane, vegetables as well as fruit trees, nursery and garden plants, lawns and gold courts, etc. In recent years their damage has been steadily increasing and is becoming more pronounced in lands fertilized with large quantities of organic manure, which is an attractive medium for ovipositing females and also serves as a suitable food for both adults and developing larvae.

Unfortunately, in Egypt, very little is known about these insects and their significant role as injurious pests has not been fully assessed.

Therefore, it has been found expedient that a detailed study of the
biology and ecology of *Pentodon bispinosus* Küst., our most common
Dynastid, to be undertaken in the Department of Entomology, Faculty
of Science, Cairo University, and in the Entomological Research Labo-
ratories of the Ministry of Agriculture.

Special stress, however, has been laid by the junior author (BISHA-
RA. 1958) on studying the structural differences between the larval
forms of *Pentodon, Temnorrhynchus* and *Phyllognathus* species and
thus can be readily identified when encountered in the soil. It is hoped
that the results obtained from the present work would shed some light
on the life of *Pentodon bispinosus* Küst. in its natural environment and
its rate of injury to agriculture and would eventually be of help as
to when and where effective control may be launched if it succeeds to
establish itself as a pest of major economic importance.

The review of literature reveals that very little has been done on
the Dynastinae of Egypt. They were first recorded by FAIRMAIRE
(1893) who described *Heteronychus cribratellus* (= *Pentodon bispino-
sus* Küst.) in Upper Egypt. WILLCOCKS (1925), mentioned the different
species occurring in Egypt and described the type of injury they cause
to sugar-cane and maize. He gave a brief account of the life-history
of *Pentodon dispar* Bdi. (= *bispinosus* Küst.) and *Heteronychus* spp.,
and emphasized further morphological and biological studies on the
immature stages of these insects. He also published ALFIERI's key for
the generic identification of the Egyptian hard-back beetles. MALOUF
(1932), gave a detailed morphology of the head of a white grub in
Egypt, and identified it as to be most probably a *Pentodon* sp. ARROW
(1937), gave a full synonymy of the Dynastinae beetles found in Egypt.
PLAUT (1953), stated that heavy root damage occurred to apple seed-
lings by grubs of a *Pentodon* species in Palestine.

These and other dynastid genera have long been considered as
injurious to agriculture in several parts of the world. BALACHOWSKY
(1925), found *Pentodon bispinosus* Küst. and *Phyllognathus silenus* F.
on palms in Algeria. DE STEFANI (1914), recorded *Phyllognathus sile-
nus* F. and *Oryctes nasicornis grypnus* on vine in Sicily. SCHINDLER
(1923) described the damage caused to vineyards in Morocco by the
larvae of *Phyllognathus silenus* F.

The genus *Pentodon* Hope, is represented by few species that
actually injure cultivated crops. *Pentodon idiota* Hbst. (= *monodon*
F.) was recorded by several workers as a pest of maize, beet, onions,
vines, ground nuts and rubber-producing plants in the Republics of
the Soviet Union. *Pentodon punctatus* Villers is considered to be a
vine pest in France, Algeria, Malta and Alba. Pyrethrum, sugar-beet

and plum are recorded to be attacked by *Pentodon punctatus* in Italy. Another important species is *Pentodon australis* Blackb. which is a pest of sugar-cane in Queensland, and of maize in N.S. Wales.

The genus *Heteronychus* Burm. comprises several species of major economic importance, namely *mashunus* Pering. (= *licas* Klug), *arator* F., *inops* Per., *dissidens* Per., *puncticollis, foveolatus, sublaevis, plebejus, sacchari* and *consimilis* as pests of maize and sugar-cane in South Africa. The "Black Beetle" *Heteronychus sanctae-helenae* Blanch. causes extensive damage to maize, sugar-cane, grape-vines, sweet potatoes, tomato, banana and strawberry in N.S. Wales.

Other dynastids of economic importance were recorded in the literature such as *Phyllognathus dionysius* F. on sugar-cane in Bombay, *Temnorrhynchus clypeatus* Klug on sugar-cane in Natal, *Oryctes rhinoceros* L. on coconut palms in India and Ceylon, *Cyclocephala (Ochrosidia) borealis* on turf in Connecticut, *Euetheola bidentata* Burm. on rice, maize and sugar-cane in Venezuela, and *Ligyrus gibbosus* (Deg.) on carrots and sunflowers in America.

From our rearing experiments of larvae, collected from various parts of Egypt, and the available adults attracted to light traps (with ultra-violet fluorescent lamps), set up in some different localities, it appeared that five dynastids are more or less common in certain regions, probably depending upon many factors such as type of soil, geographical situation, and the environmental conditions prevailing of temperature, humidity and rainfall.

The well-known *Pentodon bispinosus* is widely distributed in Lower and Upper Egypt and even in the Oases, but is less common near the Mediterranean Sea coast.

Temnorrhynchus baal, is common along the Mediterranean Sea coast, eastern of Alexandria and southwards where several crops and fruit trees are cultivated ; it occurs also in Sharkia, Kaliubia, Giza, and Gerga regions. It prefers the light sandy soil.

Phyllognathus excavatus is the dominant representative that exists in the narrow, sandy, poorly cultivated belt along the Mediterranean Sea coast, western of Alexandria, passing by Borg-el-Arab, Marsa-Matruh and Sallum. It occurs also in Kafr-el-Sheikh and in North Sinai ; very few individuals are met with near Cairo.

Heteronychus licas and *H. parumpunctatus* are widely distributed among maize fields in Kafr-el-Sheikh, Sharkia, Dakahlia, Barrage, Giza and Kena regions.

These dynastids are also known in nearly all the countries of the Mediterranean region, e.g. Spain, Balearic Islands, South France, Sar-

dinia, Italy, Sicily, Greece, Cyprus, North Africa, Mesopotamia, Syria and Asia Minor (ARROW, 1937).

II.   MATERIAL, METHODS AND TECHNIQUE

Our experiments began in February, 1956, at Giza near Cairo, for about three years both in the field and in the laboratory.   The field experiments included the study of the populations and ecology of the beetles at different times of the year.   This was carried out in two ways :

(a)   Digging out. regularly every week and sometimes at smaller intervals, soil samples one square foot or one square yard in area and one foot deep.   The samples were carefully examined for the adults and other immature stages, which were collected and entered as to their number and the depth at which they were found.   This method was almost the same as that followed by GYRISCO et al. (1945).

The micro-climatic conditions of the soil, such as the soil temperature and the moisture content, were also measured.   The former was measured daily by means of L-shaped soil thermometers at three depths in the ground : 5, 10 and 20 cm. in three different localities where the insects were abundant.   The first locality was grassland, the second was wet and the third was dry field.   The soil moisture was measured in many diggings at every two inch level in the ground up to a depth of eight inches.   The moisture content of a certain soil sample was estimated by determining the loss in weight of 100 gm. of the soil when placed in an oven at 105°C. for about three hours.

(b)   The second experiment was carried out to determine the population and abundance of the adult beetles in the field.   This was achieved by using seven ultra-violet light traps set up at various localities and daily catches of the different species of the beetles were recorded for more than two years.

Laboratory experiments were carried out under room conditions and at constant temperatures (25.5, 28 and 32°C.) and a suitable moisture condition.

The life-span and the fecundity of the adult were determined by placing freshly emerged beetles in pairs in tall jars or tins containing at their bottom about two inches of moist soil and their mouths covered with muslin which was secured to the top of the jar or tin by a rubber band.   Germinated maize grains together with some organic manure provided the food for the adults.   The soil in the containers were changed twice a week and the soil was seived through a 1 mm. wire gauze and the eggs found were collected and counted.

III.   BIOLOGY AND GENERATIONS

Pentodon bispinosus Küst. has a 1-year life-cycle, but overlapping of generations is well illustrated. Principally, there are two main generations : "1" and "2b" ; another less important one "2a" exists. The three generations are completed in sixteen months (Fig. 1).
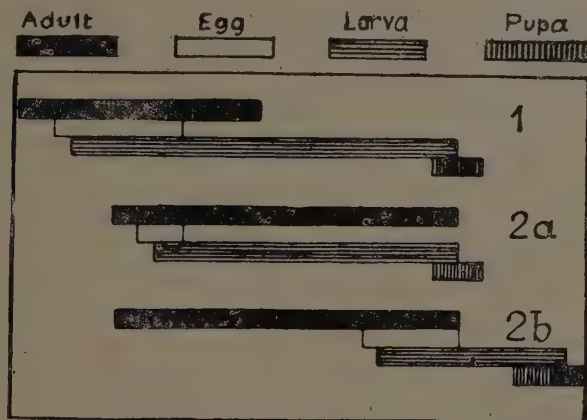
FIG. 1: Generations of *Pentodon bispinosus* Küst.

. A. — Adults of generation "1" emerge from the soil during the first week of June, with a peak of flight in July and August. The beetles are long-lived, reaching as late as the end of December, but the flight activity is greatly diminished by the autumn, and ceases during December. Pre-oviposition period lasts about a month. The females do not lay all their eggs at once, but gradually, at small intervals over a prolonged period of time, naturally leading to overlapping of stages. Oviposition ceases near the last week of October. Eggs are deposited singly and scattered about in the soil, usually of grassland, 2-3 inches deep, and frequently deeper among the roots of other field crops. Incubation requires about two weeks. Newly hatching first instar larvae reach the second stage in a 3 to 4 weeks period and moult to the third stage after a somewhat longer interval. The overwintering stage ordinarily is the third instar larva, and pupation occurs in May. Those larvae hatching late in the summer, will pass the winter as first instar, and more often as second instar grubs, and moult to the succeeding stages near the end of March, and will pupate later than the grubs previously hibernating as third instars. After a 3 to

6 days prepupal period, pupation takes place near the third week of May and lasts about 2 to 3 weeks. The adults remain in the pupal cells for 2 to 4 days after which, they burrow in the soil searching for food. The beetles start feeding five days after leaving the pupal cell, but emergence from the soil occurs principally two or three weeks later.

B. — Adults of generation "2", emerge from the soil during the first week of September. Flight is active till the last week of October, and is sluggish in November, then the beetles burrow in the soil to overwinter. Emergence from the overwintering cells starts during the last week of February, with a peak of flight in April. The number of alive adults is greatly diminished near the end of May, but some individuals may remain active until the middle of June. The female beetles have two oviposition periods, the first in the autumn till near the end of October, and the second in the following spring during April, May and a part of June, consequently a sexual diapause during winter really exists. The eggs laid in September and October give rise to generation "2a", whose larvae overwinter as second instar grubs ; few individuals may pass the winter in the first stage. Ecdysis to the following instars occurs in the latter part of March. Pupation starts in June and the beetles emerge two or three weeks later. Generation "2a" is thus completed in about ten months.

The overwintering adults emerge from the soil in late February, but no eggs are deposited before the last week of March ; oviposition period may reach mid-June, with maximum number of eggs being laid during April. These eggs give rise to generation "2b", the larvae start pupating from the beginning of August, and the adults issue forth late in the month, and emerge from the soil two weeks later with a peak of flight during September, thus giving a 1-year life-cycle.

It can be concluded that generations "1" and "2b" lead to the same generations in a year's time, but generation "2a" contributes to the population of generation "1".

1.   Emergence

The adult, when emerging from the pupal exuvia, is found lying on its dorsal surface, a position already maintained in the prepupal and pupal stages. Three or four days before emergence, many parts of the body can be seen through the pupal skin, such as the eyes, the thorax, the wings and the legs. The movements of the legs. which are directed upwards, cause the covering skin to rupture, only in the thoracic region on the ventral side of the insect. The rupture may

extend to the first or second abdominal segments. An opening with irregular outline is thus formed through which the beetle comes out. The cast-off pupal skin, found near the emerging adult, is brown in colour and its parts are not brought together to the rear of the insect, as occurring during the larval ecdysis. The newly emerging adult has a reddish-brown colouration, the ventral surface of the abdomen being somewhat light in colour. The adult stays inactive on its dorsal surface for about seven hours, but slight movements of the legs can be observed. One day after emergence, the adult moves inside the pupal cell, taking the position on its legs or lying on one side, and may stay as such for a period of 2 to 4 days. It then leaves the pupal cell which is often broken, and burrows in the soil in any direction searching for food. Black colouration is attained nearly on the fifth day. Emergence from the soil occurs principally after a 2 to 3 weeks pre-flight period, depending upon the cumulative effects of heat, including air temperature and that of the surface soil. Average pre-flight period at 32°C. in an incubator was found to be about 17 days.

Soil temperature, 5 cm. deep under grass, that was enough to stimulate first emergence of the hibernating adults of generation "2b" from the soil, appeared to be approximately 18°C.

2. Habits and habitat

Adults *Pentodon bispinosus* are nocturnal in habits. They hide during the day in small earthern cells 5-7 cm. deep, and leave the soil nearly every evening, 1–15 minutes after sundown, walk for sometime without much agility and then get in flight. They fly rapidly and straight towards powerful sources of light, and sometimes high in the air. Light is a major factor affecting flight. Beetle flight begins at a light intensity of about three international lux, as measured by MAVUX-GIGANT luxmeter. A great percentage of the bettle catch on a light trap was obtained within one hour after sunset.

Relation of temperature to flight

It was observed that on warm nights the beetles are extremely active and the catch of the light trap is great, while during cool nights flight is sluggish. Below 18°C. (air temperature at 2 metres), the activity of the adults is greatly reduced. No flights at all have been observed at air temperatures below 14°C. 18°C. is the average air temperature after sunset in November and February, while during December and January it is often below 14°C. Few adults were attracted to Giza light trap on the evenings of the 16th and 17th of

December 1957, the air temperature (at 2 metres) being raised during the daytime up to 29.5°C., and at sunset it reached about 20°C. The maximum soil temperature, 15 cm. deep under grass, was 16.5°C., which was 4°C. above the level during December and January.

Return of the beetles to the ground is supposed to be few hours after emergence, since none of the vital processes of life occur over the surface of the soil. Flight is essential as regards : (*a*) searching for food supply, or moving from injured host plants to healthy ones ; (*b*) sexes seeking for each other ; (*c*) females choosing suitable places for oviposition.

These processes cannot be carried out during the day, owing to the small distances that the beetles can move horizontally beneath the surface of the soil, regarding that they avoid flying in day light. As soon as they find land areas with good vegetative cover, and the soil texture is light, easy to penetrate and sufficiently wet, the female beetles, each one may be followed by a male, then burrow to a small depth for copulation, feeding or oviposition.

The depth of the earthen cell in which the adult hides during the ·day is subject to several factors :

(1)   Soil temperature which is greatly affected by : (*a*) the air temperature, which naturally changes according to season ; (*b*) the soil moisture content, the dry soil possessing higher temperatures than wet soil ; (*c*) the vegetative cover, which protects the surface soil from direct sunshine, a case not achieved in the bare soil, or when the field plants are still young. Optimum soil temperatures ranged between 22 and 30°C.

(2)   Soil moisture content which is necessary for : (*a*) the construction of the earthen cell ; (*b*) the wet atmosphere required for egg-deposition ; (*c*) for food assimilation. Optimum soil moisture content ranged between 10 and 15%. Thus, it was observed that the beetles burrow deeper in dry soil than in wet soil.

(3)   Depth of the attacked part of the host plant which varies between 5 cm. deep as in the case of grass, and 20-30 cm. deep as in the case of sugar-cane.

(4)   Type of soil : usually the hiding cell is deeper in light than in solid soil. In grassland with a good vegetative cover, possessing a dense mat of root system, and where the soil is quite damp, the beetles hide 5-7 cm. deep, the soil temperature at that depth ranging between 22 and 30°C. during the summer. In winter, the adults construct their hibernation cells 15-17 cm. deep, the soil temperature being 11-14°C.

Effect of irrigation

The adults though hiding during the day below the surface of the earth, yet they cannot resist water of irrigation. Many times the beetles were found floating over the surface of the water, swimming for a while until they reached parts of the land uncovered with water, suitable for burrowing. In golf courses, ten minutes after heavy watering, the beetles start getting out of the grass soil, walk for some time, until the water diffuses in the ground, then they burrow again for hiding.

Relation of nature of soil to beetle abundance

Soil samples taken from infested areas, were chemically and mechanically analysed. Most Egyptian soils are slightly alkaline, pH value ranging between 7.4 and 8.5, but the beetles were found to be more common in the areas of lowest alkalinity, and that is why we often find them in lands fertilized with organic manures, usually the dung of cattle. LE GEYT WORSLEY (1928), working on the hydrogen-ion concentration of Egyptian soils, stated that the "pH increases as the clay content increases". This fact explains the preference of *Pentodon bispinosus* to light sandy soils with low alkalinity, or rich in organic matter which decreases the pH value of the soil. Egyptian farmers collect the animal refuse, and construct big heaps, to be broadcast in the fields before crop cultivation. Six months old manure heaps attract many adults for feeding and egg-laying, at the lower wet part. New heaps seem to be undesirable, for its high moisture content and the organic matter being not sufficiently analysed to attract the beetles. An important property of the organic manure, when added to the soil, is that it retains the moisture content, improving the soil texture and providing a certain heat during the process of decomposition, which may help the insects to support the low temperatures of the soil during winter. The pH of soils rich in organic matter varies between 6.9 and 7.2. The *Pentodon* beetles were found all over Egypt, in the deserts, in the valleys, in the Nile islands and near the sea coast, with different types of soil and salt content, but they prefer lands of low salinity content and light sandy loam type. Optimum soil salinity ranged between 0.1 and 0.3%. In Kafr-el-Sheikh, where *Pentodon* is well established, the soil salinity in the cultivated areas reached 0.5%.

Death of the beetles

Before dying, the beetles are found over the surface of the soil (both in the field and in the breeding cages), lying on their dorsal sides, with their legs and maxillae showing slight movements for one

or two days. The genitalia·of the two sexes are often partly protrud-
ing, especially those of the males, exhibiting the apical fleshy part of
the aedeagus and sometimes the tips of the highly chitinized genitalia.
Occasionally, dead beetles were found under the surface of the soil.

3.   Seasonal abundance

Light traps with ultra-violet fluorescent lamps, proved to be very
helpful in studying the seasonal abundance of the adults. WILLIAMS
et al. (1955), working on the insect light traps, stated that ultra-violet
lamps are more efficient than ordinary lamps 1½-3 times. Ordinary
lamps, however, failed to attract but few beetles during our work, and
thus were replaced by the other type. Daily light-trap data at several
parts of Egypt between 1955 and 1958, indicate February 16th as the
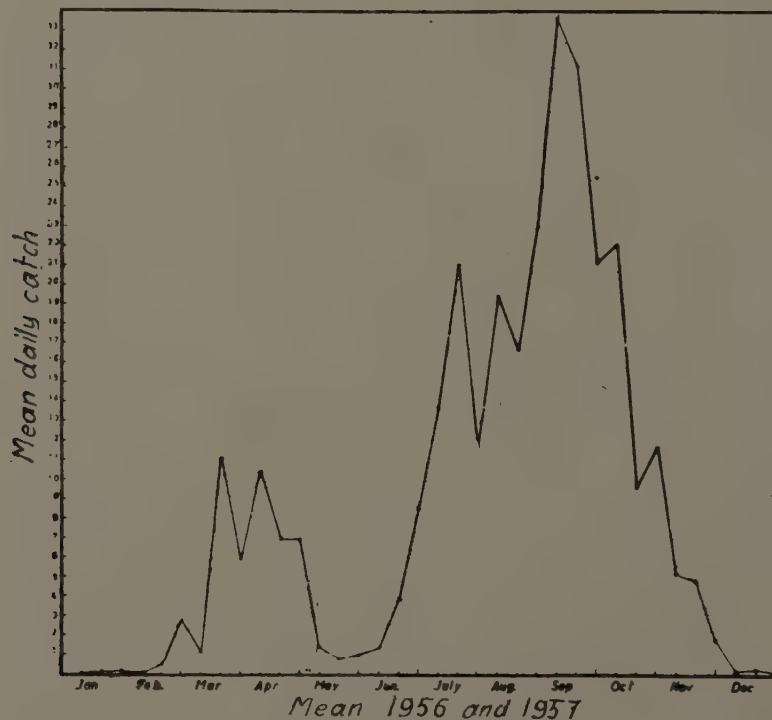
FIG. 2: Mean daily catch, every one-third of a month, of the·adults of
Pentodon bispinosus Küst.

earliest flight of adults, and November 30th as the latest. The hibernating adults of generation "2b", emerge from the soil in February with a peak of flight in April (Fig. 2). The maximum average daily catch being 11.15. The population then decreases gradually and the trap yield is very poor towards the end of May. The beetles of generation "1" start getting in flight on the second week of June, with a maximum catch during July and August, regarding that generation "2a" contributes to the population. The maximum beetle catches all over the flight season were taken during September and October, the maximum average daily yield being 33.55. This can be attributed to the following considerations : (*a*) the weather is suitable for adult activity ; (*b*) beetles of the three generations are in flight during these two months ; (*c*) the adult population of generation "2b" emerging in September exceeds in number that of generation "1", because the larvae of generation "2b" mature during the spring and summer providing favourable environmental conditions ; in contrast with the larvae of generations "1" and "2a" that overwinter, and their population, is greatly reduced, suffering from the severe climatic conditions.

The adult activity is greatly diminished during November, the average daily catch is about 5 beetles, and ceases in December and January, except at abnormal warm nights.

Periodic field diggings showed that during the adult seasonal abundance, 20 beetles may be found in a square yard of severely infested grassland, while in late winter approximately one beetle was found per 5 square yards. This explains the relatively small population of adults emerging in spring, as compared with the beetles in flight in late summer.

4. Food and feeding habits

Feeding of adults occurs under the surface of the soil, in the laboratory and in the field, during the day, and probably at night after returning to the soil from their flight.

Observations in the laboratory

The adult starts feeding nearly on the fourth day after emergence. Newly sown maize grains proved an excellent and highly favourite food supply. The beetles rupture the cuticle and feed upon the inner contents of the germinating seeds. A female beetle given eight maize grains, consumed five of them in five days at 32°C. Two out of five

were only partly injured, the others were totally emptied, the outer hard cuticle remaining being irregularly ruptured from one side. The adults attacked the grains at any part, but the region of the embryo seemed preferable. No injury had ever been observed to maize seeds under dry conditions.

The beetles were reared satisfactorily, for about eight months in the laboratory in soil rich in organic matter, prepared by mixing soil with old animal refuse (these adults were of generation "2" emerging in September and overwintered in the laboratory). Several times they were given fresh green leaves of different plants and potato tubers, but no signs of feeding appeared. Germinating seeds of wheat and beans were not attacked.

Observations in the field

Most of the beetles collected from the fields were found under grass, feeding on the roots and subterranean rhizomes, and as a result, dead yellow patches were observed scattered among the green grassland. Several times diggings were made in manure heaps, situated on the sides of the fields. The old heaps contained many adults at the lower wet parts. The organic matter it contained seemed to be a good source of food for the beetles.

The adults attack germinating maize seeds in the field, and empty their inner contents, causing death to the seedlings just appearing above the surface of the soil, and often the injury occurs to the wet grains at a very early stage of germination, and sometimes before the appearance of the radicle, this means two or three days after sowing. The beetles do not confine their attacks to maize grains, but feed also on the internal part of the stem below the surface of the soil, of young maize and sugar-cane plants. The adult gouges out a hole characterised by a fringe of retted fibres around it, which often penetrates to the tender growing point, resulting in a shoot with a dead heart. Yellow leaves indicate the death of the injured plant, which can be easily pulled out of the soil by hand.

Fortunately, sugar-cane plantations in Upper Egypt are rarely attacked by *Pentodon bispinosus* and the other native dynastids, possibly because of the long periods the cane areas are left without cultivation, as a rest for the earth during which the soil moisture is greatly reduced and the soil temperatures are unbearable for the insect life, as was recorded by Mc Kenzie-Taylor et al. (1924) in Egyptian fallow lands. Beetle injury to maize fields in Egypt is not easily detected or

estimated because maize is sown thickly, the seed being dropped into the furrow behind the plough, and the surplus plants are gradually thinned out and fed to cattle ; the poorly grown and insect attacked plants are selected for elimination.

5.   Hibernation

The adults of generations "1" and "2", emerging in June and September, respectively, are active till the end of October.   Their activity is greatly diminished during November when they burrow deeper in the soil and construct their earthen cells 15 cm. deep, preparatory for hibernation.   The few individuals of generation "1" remaining alive till December, die during this month inside their hiding cells.   The beetles of generation "2" stay inactive in their overwintering cells passing a state of complete diapause.   No flight, feeding, mating or egg-deposition have ever been observed during December, January and a great part of February.   Abnormal heat during winter may cause few individuals to leave their hibernation cells and get in flight during the hot period only as what happened on the evenings of the 16th and 17th of December, 1957.   The adults then start emerging again from the soil during the last week of February and feeding commences at once.   The empty ovaries of the female during winter start producing eggs which mature in about four weeks.   Dissection of adults during winter shows that their bodies are full of fat bodies.

Beetles likely to hibernate were kept in an incubator at the constant temperatures 28 and 32°C. ; they remained active and emerged from the soil as usual.   Feeding and egg-laying were continuous. When hibernating adults of generation "2" were held in an incubator at 25.5°C. on January 15, i.e. two months after going into hibernation, they left their earthen cells few hours later, and feeding started.   First egg was obtained 24 days later.   These experiments indicate that the temperature is the major factor affecting beetle diapause.

6.   Longevity

Adults of generation "1" emerging in June, live approximately $5\frac{1}{2}$ months under field conditions. A small population reaches November, and very few individuals may be found in December.

Adults of generation "2" emerging in September, live for about nine months, a period which is interrupted in the middle by the three months of winter diapause.

This indicates that the interference of a cold period during the adult activity leads to an expansion in the length of its life, until favourable environmental conditions prevail again, then the beetles re-emerge, and a 2 to 3 months period of flight, feeding and oviposition is continued.

Pairs of mating adults of generation "1", emerging in June, were confined in small tins containing two inches of sifted light soil and held in an incubator at 32°C.; the soil was kept sufficiently wet, and sown maize grains were introduced as food for the beetles and renewed when consumed. This experiment was carried out during the two years, 1957 and 1958; lower temperatures were not available because the room temperature reached about 30°C. during summer. Individual longevity of the adults proved that a small percentage of the beetles reached October and died during the first half of that month, which is obviously earlier than in the case of beetles under field conditions. Maximum longevity for the adults of generation "1" at 32°C. in 1957 and 1958, was 127 and 125 days, respectively, while the minimum was 83 and 78 days, respectively. The average mean for the two years being 101 days.

Similar experiments were carried out with the beetles of generation "2" emerging in September. The confined adults were kept at the two constant temperatures, 28 and 32°C. Of twenty-five pairs held at 32°C., the majority died before the end of December; only thirteen beetles, mostly females, reached January, the last one died on the 13th of that month.

From the other group of generation "2", kept at 28°C., 80% of the beetles died before the end of January; the rest, mostly females, ended their lives during February.

These experiments indicate that the longevity of *Pentodon bispinosus* adults, is shorter at 32 than at 28°C.; in the former it ranges between 85 and 134 days (with an average of 110.07 days) whereas in the latter between 103 and 167 days (with an average of 133.2 days).

During the breeding experiments it was noticed that male adults die before females. At the constant temperatures 28 and 32°C., the average longevity of the male was 8-10 days shorter than that of the female irrespective of the generation. The daily catch of light traps showed that the females exceed in number the males during May, which is the last month in the life of beetles of generation "2b".

Extremely high and low temperatures, lack of food and other inimical factors, influence the period of adult life considerably. The beetles can resist drought for long periods during winter, but in sum-

mer ten days were found to be the maximum period for adult life
without food, in dry soil of less than 4% moisture content at 32°C.
41°C. was found to be fatal to adults in about 3 days. Temperatures
below 10°C. are quite unfavourable ; adults kept at 0°C. perish after
about seven hours.

7.   Mating

Pairs of beetles were several times observed in copula during our
periodic diggings in the infested lands. Copulation occurred during
the day, in the laboratory and in the field, 10-15 cm. deep in small
burrows in the soil. During mating the male was found in a perpen-
dicular position with the female body ; the metathoracic legs of the
male touching the female elytra ; the first and second pairs of legs
being stretched inside the earthen cell, possibly for keeping equili-
brium ; the last two abdominal sternites of the male were close to the
last abdominal tergite of the female ; the highly chitinized L-shaped
male genitalia protruding and a great part of it was inside the female
body, widely opening the female genital aperture for the entrance of
the apical fleshy part of the aedeagus. The maximum observed period
of the act of copulation lasted for about nine hours at 28°C. (± 1°C.),
the actual period may last longer. The first mating for a certain
female takes place nearly 3 weeks after emergence from the pupa.
Mating may occur 4 or 5 times during the female's life, at long intervals
and with different males. When a copulating pair was brought on
the surface of the upturned soil, the female burrows quickly pulling
the male behind it, below the surface of the earth. When the male
and female are disturbed during copulation, they soon separate from
one another.

8.   Oviposition and fecundity

Pre-oviposition period

Dissection of females captured daily during the entire flight period
indicated that the eggs inside the ovaries took a long time to reach
maturity. The hibernating beetles of generation "2b", re-emerging
from the soil during the last week of February, which is the commen-
cement of the flight period, have their ovaries empty. The production
of eggs starts one week later, and mature eggs appear in the ovaries
during the third week of March (mature eggs measuring 3 mm. in
length or more). Few eggs are found in the field during the last week

of March, but increase in number during April. Beetles of generation "1" emerging during the first week of June possess a 3 to 4 weeks pre-oviposition period.

Dissection of reared females in the laboratory at small intervals after beetle emergence from the pupal stage, showed that the first appearance of eggs inside the ovaries was nearly 6-7 days after emergence, and the first mature egg was produced inside the ovary on the 18th day at 32°C. Maximum number of mature eggs ever found in a female during the oviposition period was 17 eggs with an average number of about 7 eggs. Maximum number of mature and immature eggs in the ovaries of a single female was 24 eggs, the average number being approximately 10 eggs.

Relation between temperature and pre-oviposition period

A series of experiments were carried out to determine the effect of temperature on the pre-oviposition period of the adults of *Pentodon bispinosus* Küst. Each female was individually confined with a single male in a small tin containing two inches of moist, sifted soil and maize grains as food. When a male beetle died it was replaced by another.

The tins were put in incubators at the constant temperatures 25.5, 28 and 32°C. The pre-oviposition period at 25.5°C., was determined for beetles of generation "2" brought from their overwintering cells in the breeding cages in the field two months after going into hibernation, i.e. by the middle of January. At 28°C., beetles of generation "2" at the beginning of September were used, while experiments at 32°C. were carried out with adults of both generations "1" and "2" emerging in September and June. The results showed that the pre-oviposition period at 25.5°C. (24-29 days) is longer than at 28°C. (21-25 days), and the period at the latter degree is still longer than at 32°C. (17-22 days).

Female beetles kept singly without males, deposited their first eggs between the 32nd and the 37th day at 25.5°C., the pre-oviposition period being rather prolonged. Newly emerged beetles reared in wet soil rich in organic matter (dung of cattle), seemed to reproduce normally, but accurate results were not recorded. Dry conditions of soil and lack of food greatly inhibit the production of eggs and the beetles die before ovipositing.

Oviposition habits

The females deposit their eggs in the soil during the daytime and seem to show a marked preference for soils covered with a mat of vegetation ; this may explain the severe infestation of grasslands which

are well served.   Shaded damp nurseries containing numerous fruit seedlings, greatly attract the beetles for egg-laying.   Exceedingly wet or dry areas are no favourable sites for oviposition.   Plant preference by the females for egg-laying was frequently observed by the great larval population under loquat seedlings, whereas the olive in the same nursery was free from infestation.   PLAUT (1953), stated that root damage occurred to apple seedlings by grubs of a *Pentodon* species in Palestine, while seedlings of quince, almond and olive in the same nursery were not affected.   FLUKE et al. (1931 and 1932) observed that June beetles are plant selective in egg-laying habits.   They avoid sweet clover for laying eggs, and that the grubs in lands cultivated with sweet clover among blue grass, are much less than in blue grass only.   CHAMBERLIN and CALLENBACH (1943) said that June bettles avoid egg-laying in deep-rooted legumes as clover and alfalfa, and prefer grasses which give a compact mass of fine roots and rhizomes on which young larvae can feed easily.   Also they find a great difficulty in burrowing through hard dry soil, a condition which is more frequent in legumes than in grasses.

Eggs are laid singly and scattered about in the soil, 2-3 eggs are occasionally found in the same lump of soil, but well separated (more probably from the same female).   Each egg is ensconced in a tiny cell structure, which is just about twice the size of the egg and is deposited without any adhering secretion around it.   This can be noticed when lumps of soil containing eggs are broken by hand, the elastic eggs are found without any soil particle being adhered to the chorion.

Field diggings indicated that the depth of the deposited eggs depends upon the type of soil, its moisture content and the vegetative cover.   In grassland, a great percentage of the eggs were found 3-5 cm. deep among the grass roots.   In the fields of wheat, maize and clover most eggs occurred 7-15 cm. deep in the soil.   The maximum depth was found in the case of sugar-cane, where the beetles laid their eggs 25-35 cm. deep in the soil.

Generally speaking, oviposition is deeper in dry than in wet soil, and in light than in solid soil.

Depth at which eggs are deposited in confinement was determined by burying 5 screen-covered, unglazed flower pots (25 cm. in height and in diameter) each to its full depth in the soil out of doors.   Wet soil was thoroughly packed in the lower part of each pot to a different height than the others, thus obtaining the first pot with the lower part packed to 20 cm. in height, and the soil in the upper part not packed.   The soil in the other four pots was packed in the lower

parts to 18, 16, 14 and 12 cm. in height, respectively. Two mating pairs of beetles were put in every pot, and sown maize grains were given as food. By examining the pots twice weekly, it was observed that the females laid their eggs in the packed soil, just below the upper friable layer.

Another series of five similar pots were completely filled with thoroughly packed soil and each pot was given two mating pairs. At intervals of few days, the soil inside the pots was removed in 1-inch layers, and the number of eggs was determined at each depth. Most of the eggs were found at depths varying between 5 and 10 cm.

Oviposition period

Female beetles of generations "1" and "2", both possess an oviposition period lasting approximately $3\frac{1}{2}$ months. For those of generation "1", it starts during the first week of July and continues, without interruption, till before the last week of October. The oviposition period of generation "2", begins from the second week of September and lasts about $1\frac{1}{2}$ months, then the winter season causes a sexual diapause, and another period of egg-laying occupying the two months of April and May completes the three and a half months.

The effect of temperature on oviposition period

The last eggs obtained under field conditions, from the two generations, were on October 24th in both 1956 and 1957, in the breeding cages ; the soil temperature at that time ranged between 20° and 22°C. at 10 cm. deep beneath grass. Daily dissection of captured and reared females showed that the ovaries were empty after that date. Occasionally, few immature eggs were found. Hibernating adults of generation "2" reared at room temperature, started laying eggs when the temperature reached 23°C.

Effect of temperature on sexual diapause

Mating pairs of beetles of generation "2" after going into their overwintering cells in the breeding cages in the field, were kept in an incubator at 25.5°C. on January 15th. One week later the eggs were produced inside the ovaries of three dissected females ; and on February 7th the first egg was laid. These beetles continued depositing eggs until they died during March and the first week of April.

This experiment shows that favourable temperature is the major factor stimulating the commencement of the oviposition period.

Fecundity records

To obtain detailed information on oviposition, mating pairs of beetles, either reared or captured on light-traps, were caged at room temperature, in individual tins containing about two inches of moist soil. Sufficient food was given and renewed at intervals. By sifting the soil twice weekly, it appeared that a single female laid approximately 1-3 eggs every 10 days. A total of 784 eggs were deposited by 80 females, ranging from 2-20 eggs a female, the mean being 9.8 eggs a female. Percentage of confined females that did not lay any eggs was 12.5%.

An experiment was done in which 50 pairs of adults were placed in 1-cubic foot, screen-covered cage of which the lower half was filled with moderately packed soil, and plenty of sown maize grains were introduced. By caging the beetles in this manner nearly natural conditions for flight and oviposition were approximated. A total of 542 eggs were found at the end of the experiment, regarding that the beetles probably not laying any eggs were included. The mean was 10.84 eggs per female, which indicated that caging the adults in small tins decreased fecundity to some extent.

Factors affecting fecundity

(a) *Effect of temperature :* Mating pairs of newly emerging beetles, were confined in small tins containing two inches of moist soil, and sufficient food consisting of sown maize grains was provided. Every group of beetles was kept in an incubator at the constant temperatures 28 and 32°C. Records at 28°C. were taken from beetles of generation "2" emerging in September while at 32°C. beetles of generations "1" and "2" (emerging in June and September respectively) were used. The average number of eggs per female was slightly higher at 28°C. than at 32°C. being 13.3 and 12.5 eggs, respectively (mean of 25 females at 28°C. and of 75 females at 32°C.).

(b) *Effect of food :* Lack of food during the larval stage greatly affects the fecundity of females. The resulting females gave a very small yield of eggs as compared with those reared under suitable conditions of nourishment, regarding that the beetles in the two cases were given sufficient food. The average number of eggs deposited by 20 females was 2 eggs a female at 32°C.

Lack of food during the adult stage is detrimental to the adult life itself.

(c)   *Effect of moisture :* No eggs were laid when the soil moisture content was less than 8%. Few eggs were deposited in soil containing 20% of moisture, the beetles found a great difficulty in moving in such a swampy soil. Optimum soil moisture content for egg-laying varied between 12 and 17%.

It may be pointed out that the female adults were never observed duing the process of egg-laying, nor the period elapsing between two successive ovipositions was recorded. An astonishing single case found on dissecting a female beetle, captured on a light-trap, was the presence of four mature eggs inside the bursa copulatrix, other than those inside the ovaries.

9.   Sex ratio

During the entire flight period, it has been observed that there are usually more females than males in the light-traps. Sex ratio among reared individuals and field collections was approximately 50-50, the higher catch of females appeared possibly to be due to a stronger attraction to light. It was found that early in the season, males outnumbered the females (2 : 1), but as the season progressed the ratio decreased to less than 1 : 1, and near the end of the flight period the females dominated the catch of the light-traps. The same situation was met within the rearing experiments, where it was difficult to maintain males in rearing cages late in the season, due to their earlier death.

IV.   SUMMARY

Biological and ecological studies were carried out on adult *Pentodon bispinosus* Küst., which is the commonest scarabaeid species injurious to agriculture in Egypt. The adults are nocturnal, active fliers and are attracted to strong sources of light. They hide during the day in earthen cells 5-15 cm. deep in the soil. Feeding, oviposition and mating occur below the surface of the earth. The beetles attack germinating maize grains in the field and in rearing cages. They also bore into sugar-cane and maize stems below the surface of the ground.

Pentodon bispinosus Küst. has a 1-year life-cycle, but overlapping of generations is well illustrated. Principally, there are two main gene-

rations: "1" and "2b"; another less important one "2a" exists. The three generations are completed in sixteen months. Beetles of generation "1" emerge from the soil in June, having a pre-oviposition period lasting about a month. Egg deposition is gradual and ceases in October. Eggs are laid singly and scattered about in the soil, their depth depending upon soil moisture and vegetation cover. The beetles live approximately six months, the larvae overwinter mostly as third instars, and pupation takes place in May.

Beetles of generation "2" emerge in September and after a short oviposition period they overwinter, passing a state of complete diapause. Re-emergence from the soil starts in late February and eggs are deposited again during April and May. The eggs laid in late summer lead to generation "2a", whose larvae overwinter as first and second stages, and pupation occurs in June. The emerging adults thus contribute to the population of generation "1". The eggs laid in spring lead to generation "2b", whose larvae mature during the summer and pupation takes place in August.

Peak of flight during the whole season occurs in September, when the beetles of the three generations are in flight.

V.   ACKNOWLEDGMENTS

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STUDIES ON THE BIOLOGY AND ECOLOGY
OF Pentodon bispinosus Kust. IN EGYPT

II. THE IMMATURE FORMS

[Coleoptera : Scarabaeidae-Dynastinae]

(with 2 Text-Figures)

by MAHMOUD HAFEZ, M.SC., PH.D., F.R.E.S.,

Head of the Department of Entomology, Faculty of Science,

Cairo University,

and SADEK I. BISHARA, M.SC.,

Senior Entomologist, Ministry of Agriculture, Egypt.

C O N T E N T S

I. INTRODUCTION

In a previous paper (*see* this Bulletin, pages 155-178), the authors gave an account of the biology and ecology of the adult *Pentodon bispinosus* Küst., the commonest Dynastid beetle in Egypt. The present paper deals with the early stages of the same species, namely the egg, larva and pupa. A note on the predators and parasites of this insect pest is also included, but further investigations are still needed to establish the identity of some of them. Suggestions on control measures mostly based on the present ecological studies are also given.

II. MATERIAL, METHODS AND TECHNIQUE

The experiments on the immature stages of *Pentodon bispinosus* Küst. were carried out both in the field and in the laboratory. The field experiments aimed at following the seasonal prevalence of the immature stages in the soil, especially the larvae, and this was carried out by digging out regularly every week and sometimes at smaller intervals, soil samples one square foot or one square yard in area and one foot deep. The specimens collected were recorded as to their number, stage of development and the depth at which they were found. The soil temperature was measured daily by means of L-shaped soil thermometers at three depths in the ground : 5, 10 and 20 cm. in three different localities where the grubs were abundant. The first locality was grassland, the second was wet and the third was dry field. The soil moisture was measured in many diggings at every two inch level in the ground up to a depth of eight inches. The moisture content of a certain soil sample was estimated by determining the loss in the weight of 100 gm. of the soil when placed in an oven at 105° C. for about three hours.

Furthermore, to determine exactly the depth at which the larvae in the various stages lie, a series of plant pots about 15 cm. wide and 20-40 cm. deep were used. Each pot was filled with compact soil of high humus content and a single grub was placed in the soil after planting a suitable plant (wheat in winter and maize in summer). The pot was then inserted full length vertically in a pit in the soil and ordinary sprinkling of the soil with water was found satisfactory to maintain suitable moisture for the larvae in the pots. The depth reached by the larvae was determined by removing the pots and empty-ing their contents carefully with a spoon till part of the larval body was visible and then returning back the soil and the plant. The plants in the pots were changed regularly to provide fresh food for the larvae. This method was found not to affect the normal life of the larvae in the pots and relatively little mortality was recorded. In this manner, the effect of climatic and other factors on the vertical movements of a certain grub throughout its life was determined under as near normal conditions as possible. Before the time of emergence of the adult beetles from the pots, these were covered by fitting tightly a semi-spherical wire screen covers to their mouths so as to prevent escape of the beetles. These latter were collected and were taken to the laboratory for further biological experiments.

The incubation period of the eggs was studied by placing newly laid eggs singly in small earthen cells in moist soil in tightly covered Petri dishes. These dishes were put under a dark cover and the eggs were examined daily for any hatchings. The effect of various atmospheric temperatures and soil moisture on the incubation period was studied. Eggs were incubated at the cosstant temperatures 25.5, 28, 32 and 35° C., in incubators. Constant moisture of a certain Petri dish was maintained by filling it with soil of known moisture content (prepared by adding a known amount of water to a known weight of oven-dried soil), and weighing the Petri dish at small intervals and adding water when necessary.
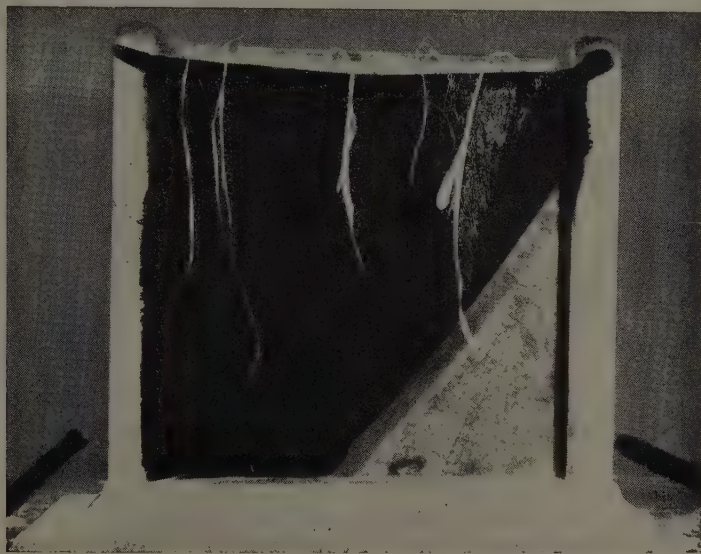
FIG. 1: Glass cage (after SANDERS and FRACKERS).

The small grubs hatching from the eggs were reared in small tins containing fine moist light sandy soil, mixed with fine root hairs and into which wheat or maize seeds were sown. These provided food for the larvae. The soil in the tins was examined regularly and was kept sufficiently moist.

When about to pupate, the larvae were removed to glass vials one inch wide and five inches long ; or the larvae were placed in glass cages

similar to those devised by SANDERS and FRACKER (1916). Each glass cage consisted of two vertical glass plates 35 × 35 cm. and 1-2 cm. apart. The plates can slide vertically in grooves in a wooden frame. Some soil is placed between the vertical glass plates and the whole cage was covered with a black cloth to avoid excessive light. This enabled close observation of the pupating larvae (Fig. 1) .

III. THE EGG STAGE

The freshly deposited egg is shiny, opaque milky white in colour, elastic and will bounce like a rubber ball if dropped on a hard surface ; ovoid in shape, it averages approximately 3.6 mm. in length and 2 mm. in width. As the time for hatching is approached, the egg assumes a more nearly spherical shape than previously and increases in size up to 4 mm. in length and 3.6 mm. in width. The growth of the embryo, in addition to a certain amount of moisture absorbed through the chorion, account for the egg swelling. The phenomenon of inward flow of water is ascertained by the increase in weight of the egg which is about 12 mg. when newly laid and reaches about 39 mg. before hatching. A similar three-times increase in weight due to the absorption of water was also reported by LAUGHLEIN (1953) in the eggs of *Phyllopertha horticola* L. (Rutelinae). The original colour of the egg changes during the last four days of incubation to pale buff. In addition, certain of the more highly sclerotised body parts can be seen through the egg-shell one or two days before hatching. These include the tips of the mandibles, many body spines and setae and sometimes the spiracles of the body segments. During the last two days of incubation, the embryo makes some movements inside the egg, flexing the body, and opening and closing the mandibles. Just previous to hatching it moves extensively.

1. Hatching mechanism.

Initial rupture of the chorion occurs in the vicinity of the metanotum, apparently brought about by the vertical pressure of a "hatching spine" or "egg burster", located in the dorso-lateral part of the metathorax, on the right side of the larva. HAYES (1930), in his work on larval Scarabaeoidea, indicated that the embryo of the Colorado potato beetle possesses hatching spines (ruptor ovi-egg bursters) consisting of three pairs of spines on the thorax. RITTERSHAUS (1927) has mentioned the occurrence of egg-bursters in *Anomala aenea* and *Phyl-*

lopertha horticola. The structure was described as two triangular-shaped chitinized spines, one on each dorso-lateral aspect of the meta-thorax. Accompanying the spine, is a stiff bristle or seta, about twice as long as the hatching spine. In the case of *Pentodon bispinosus* Küst., the hatching spine appeared as an acute protrusion from below the egg-shell, but after hatching it was hard to differentiate between this special spine and the surrounding setae. The action of the spine is accompanied by the pressure of the larval legs on the ventral side of the egg-shell, in addition to the body contortions of the embryo. During the process of escaping from the chorion, the larva exerts considerable physical effort. The grub required about ten minutes to extricate itself from the egg-shell.

2. Incubation period

Eggs were incubated on very wet soil in covered Petri dishes, presumably resulting in a saturated atmosphere, and held at the constant temperatures 25.5, 28, 32 and 35°C. The incubation period varied from 7-17 days depending on temperature. On an average, it was 14.3 days at 25.5°C. (12-17 days), 11.8 days at 28°C. (10-13 days), 9.8 days at 32°C. (9-12 days) and 8.1 days at 35°C. (7-9 days). At 37°C., however, the eggs failed to hatch.

IV. THE LARVAL STAGE

1. Larval instars

Pentodon bispinosus Küst., like all Scarabaeidae, has three larval stages. The first and second instar larvae resemble the third instar (Fig. 2), previously described by BISHARA (1958) but differ in the width of the head and the size of the body. The mean head width is 3.0 mm. (3.0-3.2 mm.), 5.0 mm. (4.2-6.0) and 7.5 mm. (6.8-8.0 mm.) for the first, second and third instars, respectively.

When newly hatched, the larva is entirely creamy-white in colour, except the scissorial and molar parts of the mandibles and the body spines which have a pale-browish colouration. In a few hours, the head capsule and other chitinous parts become brownish-yellow in colour, the mandibles usually darker. The average length of the body is about 6 mm. Maximum body length ever reached by the first instar

larva is about 28 mm. The young grub leaves the egg-cell half an hour after hatching and moves on the surface of the soil, when the eggs are incubated in Petri dishes in the laboratory. Burrowing in the soil occurs 1-2 hours later. Mortality was high, especially during the fist week after hatching, owing to their great sensitivity to environmental changes and handling technique. The larva before moulting tends to move downward slightly in the breeding vials and passes a 3-day period of inactivity and no feeding. Ecdysis of the larva occurs through a longitudinal cut, along the mid-dorsal line of the body, extending from the head capsule anteriorly, and reaching the second or third abdominal segment posteriorly. The epicranial suture splits at the time of moulting and the split is continued into the frontal sutures.

FIG. 2: Third instar larva of *Pentodon bispinosus* Küst., × 2.

Just after moulting, the head capsule of the second instar larva is whitish in colour. The larval body at that time is nearly about the same size of the fully developed first instar grub. Maximum length reached by the second instar larval body is about 52 mm. as measured from the anterior end of the frons to the anus.

2.   Larval habits and food

The larva is typical scarabaeiform, in its normal resting position it lies curled with its head near its anal end in the form of a horse-shoe. The larval stage is spent below the surface of the soil, among the plant roots. Grub movement by all the instars, both vertically and horizontally ,is rather slow and for short distances depending upon temperature, humidity, food and nature of soil. Under suitabl eenvironmental

conditions and good vegetative cover as in lawns, the larval move-
ment is limited to a great extent ; while in fields where the plants are
scattered, the grubs move horizontally for comparatively long dis-
tances. It was observed that the larva usually burrows in the soil by
means of the pro- and mesothoracic pairs of legs, and this may explain
the stronger and bigger size of the claws located at the tips of the first
and second pairs of legs rather than those of the third pair.

Feeding of the grubs starts few hours after hatching in the case
of the first instar larva, or after moulting in the case of the second and
third instars. Soon after feeding begins the whole body attains a grey-
ish coloration due to the accumulation of the ingested food in the
alimentary canal, which can be observed through the thinly sclerotised
body integument. Later, the accumulation of the fat bodies in the
anterior part of the body restricts the dark coloration to the last two
abdominal segments, and the rest of the body is creamy white in
colour, being a typical "White Grub". This proved to be a good means
of differentiating between newly moulting and well developed larvae
of the same stage in the field.

Food of larvae, in the field and in the laboratory, consisted mainly
of plant roots, and a certain amount of dead organic matter mixed with
soil particles. Larval faeces normally contained a great percentage of
soil particles, which settled down at the bottom of the watch-glass
when examined under the microscope. The great resemblances between
the colour of the larval faeces and the soil in which the larva lives,
indicates that soil particles constitute a certain percentage of the larval
ingestions. In the case of larvae brought from inside sugar-cane sub-
terranean stools, nearly all the faeces consisted of cane fibres.

The larvae were reared in the laboratory on germinating maize
and wheat in different types of breeding cages, previously described.
Larvae matured satisfactorily in pure wet organic manure (dung of
cattle).

The following list comprises the plants that were found actually
attacked by the grubs of *Pentodon bispinosus* Küst. in the field : sugar-
cane (*Saccharum officinarum* L.), maize (*Zea mays* L.), wheat (*Triti-
cum vulgare* Vill.), cotton (*Gossypium barbadense* L.), Egyptian clover
(*Trifolium Alexandrinum* L.), cabbage (*Brassica oleracea* var. *capita-
ta*), cauliflower (*Brassica oleracea* var. *botrytis*), beet-root (*Beta vulga-
ris* var. *rapa*), cow-pea (*Dolichos sesquipedalis* L.), artichoke (*Cynara
cardunculus* var. *scolymus*), vegetable marrow (*Cucurbita pepo* var.
ovifera), pear (*Pyrus communis* L.), wild pear (*Pyrus communis* var.
achras), apple (*Pyrus malus* L.), mango (*Mangifera indica* L.), loquat

(*Eriobotrya japonica* Lindl.), water melon (*Citrullus vulgaris* Schrad.), sweet melon (*Cucumis dudaim* var. e*gyptiacus*), camphor (*Cinnamomum camphora*), eucalyptus (*Eucalyptus flobulus* Labill.), poplar (*Populus* sp.), lawn grass (*Lolium perenne* L.), Bermuda grass (*Cynodon dactylon* Pers.), common pea (*Pisum sativum* L.), common potato (*Solanum tuberosum* L.), grape vine (*Vitis vinifera* L.), youth and old age (*Zinia elegans* Jacq.).

Grass roots and rhizomes proved to be the most favourite diet for the grubs.

3.   The normal environment of the larva

Under normal conditions, the larvae live in the soil among the plant roots in the fields, and in the lower wet parts of manure heaps, i.e. with the adults in the same habitat. Lawns and golf-courses were found to be the most severely infested land areas, where several types of grasses were grown. Dense larval populations reaching about 70 grubs per one square yard, were found in grasses of heavier types, giving good cover and possessing a thick mat of root system. It was observed that grasslands retain soil moisture content much more than bare areas.

The grub constructs for itself an earthen cell with smooth inner walls achieved by the semi-circular repeated movement of the caudal end of the body. The cell is just bigger than the size of the grub. It can be constructed in compact soil but not in dry and friable one. When the soil moisture is greatly increased, drainage of the excess water occurs through a small irregular opening which is formed opposite to the regular main opening of the earthen cell. The larval cells afford a degree of immunity against excess dryness and moisture.

In grasslands, where optimum conditions for larval development and activity are prevailing, the grubs live in the surface soil 3-7 cm. deep, when the soil temperatures range between 20 and 30° C. as in the spring and summer. The larvae tend to go deeper in the autumn, and overwintering cells occur at a depth of 15-20 cm. where the soil temperature varies between 11 and 15° C., while at 5 cm. deep it may decrease to 7° C. The larval depth in the field is usually greater than in grasslands, and differs according to the attacked part of the host plant, ranging between 5-10 cm., when plant seedlings are attacked and 25-35 cm. as in the case of infested sugar-cane sets and roots. The depth of the larvae depends also upon the type of soil ; in sandy soil the larvae usually go deeper than in solid soil.

THE EFFECT OF MOISTURE ON LARVAL BEHAVIOUR.—Decrease of moisture in the upper layer of soil, causes downward movement of the grubs. Larvae placed over the surface of the soil in breeding cages, burrowed and constructed their earthen cells in the lower wet compact region, just below the top friable layer of soil. Full grown larvae can resist drought much more than young ones. Twenty third-instar larvae, lived about four weeks in dry organic manure containing about 7% moisture content. Newly hatching larvae died after 12-24 hours. Fifty grubs of different stages behaved normally in sandy soil containing 5% soil moisture at 20-24°C., and with plenty of food. The majority of larvae subjected to excess water perished after two days. Soil of 20.6% moisture content was found fatal to the larvae, while soil rich in organic matter containing 20.1% moisture proved to be quite suitable for the larval life. This may be attributed to the fact that the dead organic matter absorbs a certain percentage of water, while in the former cose, the water fills the spaces between the soil particles and larval breathing seems to be hindered. The organic manure is thus considered to improve the physical conditions of the soil. Optimum soil moisture content for larval development ranged between 12 and 17%.

THE EFFECT OF TEMPERATURE ON LARVAL DEVELOPMENT.—Optimum temperatures for larval development ranged between 24 and 31° C. Overwintering larvae start moving upwards for feeding when the soil temperature reaches 21° C., in glass cages in the laboratory. Overwintering third instar larvae when kept at 25.5° C. in an incubator on December 12, started feeding at once and prepupated 11-14 days later, and adults emerged in January. Overwintering first and second instar larvae moult near the end of March under field conditions, when the soil temperatures range between 19 and 22° C. When kept in December 12 at 25.5° C., moulting occurred 7-18 days later. Below 19° C., larval activity becomes greatly diminished. Third instar larvae when subjected to 37° C. in an incubator the majority died after 15-25 days. Very few individuals produced dwarf males and females, unable of folding their elytra and soon died.

The decrease in the larval populations of *Pentodon bispinosus* during winter in Egypt, was obvious when examining the grub estimates in April 1958. A severely infested grassland near Cairo contained about 8 larvae per square foot in October 1957 ; in April 1958 it was about 2 larvae per square yard.

4. ·Rate of injury

Damage caused to any plant depends upon the stage of the larvae feeding on it. The third larval stage is the most destructive period in the life of the grub. Second ·instar larvae cause less injury to host plants. First instar grubs consume comparatively small number of fine roots, and thus their damage is considered negligible.

Type of injury differs from one plant to another, according to the part of the plant attacked by the larvae. In lawns, the grubs feed on the grass roots and subterranean rhizomes, and as a result, yellow patches appear scattered among the greengrass areas. Severely in-fested grass can be pulled out easily by hand and rolled like a carpet. Roots of wheat seedlings are definitely eaten off just below the surface of the soil, and yellow leaves indicate the death of the plant. Young nursery plants of pear, loquat, apple, mango, camphor and eucalyptus, when attacked by the grubs, the roots are found obliquely cut 5-7 cm. below the surface of the soil, the main root below this level and the root hairs being totally consumed. When the plant is ·1-year old, the grub cannot injure the upper part of the root especially the inner hard xylem, thus it feeds on the outer layer around the main root which is characteristic of the grub attack. Usually one larva is found at the base of each plant, feeding on the roots, until it is killed and then the grub moves to the adjacent healthy plant. Few larvae, about 11 per square yard, caused severe damage to pear and loquat seedlings, reach-ing approximately 10%.

In the case of sugar-cane, the larvae bore inside the cane-sets, some enter through the ends, while others bore through the rind, generally from the lower side, into the interior of the sets, and feed extensively on the inner sugary fibres, and as a result the stool or cane-set appears as a hollow tube with several side holes full of red fungus. Three to four larvae may be found inside one stool, compris-ing two nodes and three inter-nodes. The larval damage extends to the roots and the lower parts of the shoots issuing from the stools. Dead plants with yellow leaves and injured hearts, easily pulled by hand, indicate the grub attack. Fortunately the sugar-cane fields are rarely attacked by *Pentodon bispinosus* and other native scarabaeids, but the damage may reach 90% in few areas.

In the case of melons, the larva attacks the main root 4-10 cm. below the ground resulting in a longitudinal deep groove from one side, which causes rapid death to the plant. Attacked vegetables have the same characteristic oblique cut of the roots, or the circular feeding

around the upper part of the main root as in the case of cow-pea. In the case of potato, the larvae, in addition to the root injury just below the surface of the ground, they bore into and feed upon the inner parts of the tubers. Grub injury to maize and clover cannot be easily detected or estimated in the field, since the two crops are thickly sown, and a part of the dense vegetation of maize and all the clover are used as a green forage for the cattle.

Severe damage to a certain infested area, usually occurs late in the summer, the grub population reaching its maximum. Fortunately the white grubs are not plenty in Egyptian fields, possibly because during a great part of the year they exist above the plough line (about 15 cm. deep) ; the larvae unearthed by the plough are preyed upon by several kinds of birds, the most efficient of those are the buff-backed egrets and the hooded crows.

5.   Duration of larval stage

The three larval instars are nearly found all the year round, as a result of the prolonged oviposition period of the long-lived female beetles.

The first instar larvae of generation "1" appear in the field during July, the soil temperature 5 cm. deep beneath the grass being 26-30.5° C. The average duration of this stage is about 22 days, ranging between 20 and 24 days at 28° C. The few individuals of the first instar hatching near the autumn, overwinter in the same stage, and moulting to the second instar occurs in the field during the last week of March and first week of April, thus reaching about five months.

At 25.5° C. the first stage moulted after 24-28 days, with an average of about 26 days ; and at 32° C. the average duration was about 19 days, ranging between 18 and 21 days, but the mortality was rather high.

First stage larvae of generation "2b", appear in the field during the latter part of April, the soil temperature 5 cm. deep beneath the grass, ranging between 18 and 24° C. The average duration of this stage is supposed to be more than 4 weeks under such field conditions. First instar larvae of generation "2b" are found in the field during April, May and a great part of June.

The second larval stage lasts about 26 days on the average at 32° C., whereas at 28 and 25.5° C. the duration is prolonged to about 30 and 35 days, respectively.

Second instar larvae of generations "1" and "2a" reaching the autumn, overwinter in the same stage and moult to the third instar during the last week of March and first week of April, lasting about 5-6 months.

Second instar larvae of generation "2b", appear in the field during June and July, the soil temperature 5 cm. deep below the grass being 23-29°C. in June, and 26-30.5°C. in July.

Larvae of generation "1", moult to the third stage near the end of September, and overwinter in that stage ; pupation takes place near the third week of May ; maximum duration of the third stage under field conditions being approximately eight months. The third instar larvae of generation "2b", appear during the third week of June, and first pupation occurs during the first week of August. The duration of the third stage is approximately seven weeks during June and July in the field. In the laboratory third instar larvae when kept in an incubator at 34° C., pupated after 28-34 days, the average being about 31 days. At 32° C., the average duration was about 43 days, while at 28° C., it was about 56 days. At 25.5° C. the maximum duration was 70 days and the minimum was 54 days with an average of about 62 days. The average total duration of the larval stage was 123 days at 25.5° C., 108 days at 28° C. and 88 days at 32° C.

It may be concluded that temperature is the major factor affecting the duration of the larval stage. Optimum temperatures ranged between 25.5 and 32° C., which prevail in the field during summer. This explains the greater larval population in late summer than in spring ; in the latter case the overwintering larvae are greatly decreased in number, and the larval activity almost ceased during winter, the soil temperature 10-20 cm. deep being about 11-14° C.

EFFECT OF FOOD ON THE DURATION OF THE LARVAL STAGE.—Lack of food during winter seems to have slight or no effect on the larval duration, while during the breeding season, the food is of ultimate importance to larval development. Maximum duration of the different larval stages without food (in wet pure sandy soil) at 28° C. was 2, 7 and 15 days for the first, second and third instars, respectively.

V. THE PUPAL STAGE

1. Prepupa and pupation

The full grown larva usually burrows deeper in the soil, about 15-20 cm. deep, and constructs for itself an elongate earthen cell, in

which it changes to the pupal stage. During the prepupal period, the grub sheds its meconium and assumes a quiscent stage preparatory to pupation. It loses its curved position and straightens out except the last two segments, which are perpendicular to the rest of the body. The larval body becomes exceedingly flaccid in appearance and texture and turns to yellowish-white in colour. Usual position of the prepupa is on its dorsal surface inside the earthen cell. It exhibits great sensitivity when disturbed or subjected to light, and moves erratically. After the short 3 to 5 days prepupal period ,the larva moults and the pupa is formed within the cast-off larval skin. The pupa takes approximately seven minutes to extricate itself from the larval exuvia, making extensive movements during moulting. The larval skin is ruptured along the mid-dorsal line from the head till the second abdominal segment. The epicranial and frontal sutures are not split during the pupal ecdysis, because the head of the pupa is not highly chitinised, and is much smaller than the larval head-capsule. Just after moulting, the pupa is creamy-white in colour and very sensitive to light, measuring approximately 2.6 × 1.6 cm. Few hours later the colour changes to yellow, and gradually darkens until just before emergence, the colour of the adult appears through the pupal skin in many parts. The breaking of the pupal earthen cell is fatal to the insect. Excess moisture or drought consequently lead to death. Optimum soil moisture content for pupal development ranged between 12 and 15%.

2. Duration of the pupal stage

Pupation of the individuals of generation "1", starts in the field during the third week of May, when the soil temperatures 10-20 cm. deep range between 23 and 25° C., and is continued in June and a small part of July, when the soil temperatures range between 25 and 29.5° C. The pupal moult of generation "2b" is accomplished during August and September. Normally, the pupal stage lasts about 2-3 weeks. The average pupal period varied with temperature ; thus it was 16 days at 25.5° C., 14 days at 28° C., and 12 days at 32° C. At room temperature ranging between 22 and 28.5° C., the average pupal period was about 22 days.

To sum up, it may be concluded that the average total length of the developmental stages from egg to adult emergence increased with decrease of temperature, being 109.8 days at 32°C., 133.8 days at 28°C. and 153.3 days at 25.5°C.

VI. PREDATORS AND PARASITES

1. Predators

Pentodon bispinosus larváe are preyed upon by some birds, the most active in this respect are the hooded crows (*Corvus corone sardonius* Klein) which peck holes in the grasslands in search for the grubs. Such holes, when scattered among the gold-courses, render the latter unsuitable for playing. Black kites (*Milvus aegyptius* Gmel.) and crows, are often seen in lawns during the watering process, waiting for the beetles that emerge by the effect of the excess water, and swallow them. The buff-backed egrets (*Ardea ibis* L.), which are common among the fields in Egypt, have often been observed following the plough, eagerly picking every insect that was unearthed, including the beetles and the grubs (KIRKPATRICK, 1925).

Several times, while digging in grasslands, ants were found attacking the eggs, usually one ant holding a single egg.

2. Parasites

In a few cases, larvae collected from the fields and reared in the laboratory, were found parasitised by hymenopterous larvae, which fed on the inner contents of the grubs through a big longitudinal rupture on the left side of the thoracic region ; this is supposed to be the site selected by the parasite for laying its egg. The grub was always attacked by a single parasitic larva. Cocoons of these parasitic larvae were found 10 cm. deep in the soil, while digging in grasslands infested with white grubs. Adults failed to emerge from the cocoons and therefore it was not possible to identify the insect which most probably belongs to the family Scoliidae, known everywhere as grub parasite and which is well represented in Egypt by several species. This point needs further investigation to be undertaken in the future. CLAUSEN et AL. (1933), working on the parasites of *Popillia japonica* Newm. in the Far East, recorded several species of the genus *Tiphia* belonging to the Scoliidae, as attacking the grubs. The wasp after paralysing the larva, deposits a single egg on the thorax or the abdomen. Each species lays its egg in a definite position on the larval body. These parasites were introduced to America to make use of them in the natural control of the Japanese beetle larvae.

Fungus diseases usually attack *Pentodon bispinosus* during all the stages of development. Eggs incubated in covered Petri dishes, attained a yellowish coloration, and when examined, white fungus

mycelia appeared surrounding each egg, and sometimes a tuft of my-
celia accumulated at one end. When cultured, the fungus disease was
identified by Dr. S. SIDKY, of the Plant Diseases Department (Ministry
of Agriculture), as being *Fusarium* sp. Diseased eggs usually failed to
hatch.

Larvae and pupae, in the rearing cages, were susceptible to an-
other fungus disease known as the «Green Muscarine" caused by
Metarrhizium sp. A compact white mycelial growth appeared cover-
ing a great part of the body, which changed to olive green in colour
after a few days. Another contaminating disease was identified as
Aspergillus sp.

These diseases were a great obstacle during rearing experiments.
In field diggings occasional specimens were found attacked by these
entomogenous fungi.

Parasitic mites were so numerous on larvae, pupae and adults in
the breeding cages, aggregating in the body grooves and intersegmental
regions. Several times, mites were found on individuals collected from
the field, manure heaps or adults caught on light traps. These mites
were identified by H. ATTIA, of the Plant Department (Ministry of Agri-
culture), as adults of Gamasid and Tyroglyphid representatives. During
the autumn and winter, the Tyroglyphid were found in a hypopus stage
and not as adults. The grub, severely attacked by mites, possesses a
yellowish and flaccid appearance, and the body integument exhibits
many small brownish spots, possibly due to punctures caused by the
mites, and finally the grub dies. Mites cause death to pupae, and im-
pede greatly the activity of the adults.

Few reared larvae, contained progidious numbers of Nematode
worms, which caused death to the grubs, and were identified as *Cepha-
lobium microbivorum* Cobb.

VII. SUGGESTIONS ON CONTROL MEASURES

Soil insects, in general, are naturally protected by the favourable
conditions available in their surroundings. Soil temperatures are
slightly affected by the fluctuations in air temperatures. Soil humid-
ity in cultivated lands, is rather constant and suitable for insect life.
Their position below the surface of the earth, decreases the attacks of
predators and parasites.

The difficulty in the scarabaeid problem lies in the fact that their
injury appears when control measures become too late and of little
value. This can be attributed to the following reasons :

(1) The beetles and grubs work out of sight and in scattered areas, and thus it is hard to predict their situations ; it is also impracticable to broadcast insecticides everywhere to protect the fields from infes-tation.

(2) The signs of attack appear when the plants are completely dead. Their damage is sudden and quick.

(3) Third instar larvae, which are the most injurious stage, can resist the usual concentrations applied of soil insecticides for long periods, as was observed in the preliminary control experiments done in several regions of Egypt.

(4) There are no satisfactory means of destroying the white grubs that are present in large fields of growing crops (LUGINBILL and CHAMBERLIN, 1953), yet complaints of natives about the grub attacks, are received a long time after cultivation.

Ploughing as a control measure

In Egypt, ploughing is considered to be an efficient method in controlling *Pentodon bispinosus* and other native Scarabaeidae, since all the stages of development exist above the plough line (practically considered as 15 cm. deep), during nearly the whole year. Eggs when subjected to direct sunlight soon perish. Unearthed larvae, pupae and adults are eagerly picked up by birds, which always follow the plough. Breakage of the earthen cell is fatal to prepupae and pupae, as has been observed in the breeding experiments. The fact that we are not troubled by this pest in lands cultivated with field crops, while lawns and golf-courses are severely infested, may be attributed mostly to the disturbance caused to insects by ploughing and other cultural practices in fields in the former case, while left undisturbed in the latter. DRAKE (1932), reported that a rotary plough killed about 96.7% of the white grubs within the plough depth. Pupae and hibernating adults were usually below the plough line, and only 4% were above that level.

Trapping of the beetles

Extensive use has been made of traps, to obtain information on the distribution of these insects in Egypt. Light traps with ultra-violet fluorescent lamps were very effective in attracting great numbers of beetles during the flight period. The idea of trapping the beetles as a control measure of the insect, is refused by some workers, e.g. FLEMING (1955), who stated that the traps capture less than 25% of the beetles in the vicinity, and may draw more beetles into the area, and thus the damage may be increased.

Control with insecticides

It was found that the best way for the control of white grubs with insecticides, is by applying the materials to the soil before ploughing and other cultural processes, to ensure their uniform distribution in the upper 15 cm. layer of soil. No doubt, the fields that need such treatment, are those which were found infested in the previous crops. Grasslands on the other hand, can be easily treated by dusts, granules or sprays, before or after plant growth, and it is advisable to wash the materials into the ground after application, by watering the grass.

It is also important to carry out the control experiments when the insect is in an early stage of development, which proved to be very sensitive to chemicals.

Some experiments for the control of white grubs in Egypt by means of insecticides, have already been started with promising results. Researches are still in progress using Aldrin, Dieldrin, Chlordane, BHC, Lindane and DDT.

VIII. SUMMARY

A detailed study on the biology and ecology of the immature stages of *Pentodon bispinosus* Küst., the scarabaeid pest most commonly distributed in Egypt, has been worked out. A previous paper by the same authors dealt with the adult stage.

The freshly laid egg is shiny, opaque milky white in colour and ovoid in shape, measuring approximately 3.6 × 2.0 mm. At a late stage of incubation, the egg is nearly spherical in shape measuring about 4 × 3.6 mm. in diameter. The growth of the embryo in addition to a certain amount of moisture absorbed through the elastic chorion, account for the egg swelling, and an increase in weight from 12 up to 39 mgm. approximately, is maintained. Just before hatching, the egg has a pale buff appearance and the young larva can be seen moving inside the egg. Initial rupture of the egg shell occurs by means of a hatching spine located on the dorso-lateral part of the metathorax, on the right side of the larva. The incubation period ranges between 7 and 17 days, depending upon temperature. Eggs require about two weeks to hatch under field conditions.

The larva, when newly hatched, is entirely creamy-white in colour, except the chewing parts of the mandibles and the body spines which have a pale brownish coloration. In a few hours the head capsule and other chitinous parts turn brownish in colour. The larva moults thrice

to reach the pupal stage. The first and second instar larvae greatly resemble the third instar, but differ in size and the head-width ; the mean head-widths for the three instars being 3.0, 5.0 and 7.5 mm., respectively. Before every ecdysis, the larva burrows somewhat deeper in the soil. The rupture of the larval skin occurs along the mid-dorsal line of the body, extending from the head till the second or third abdominal segments. The epicranial suture is ruptured during moulting and the split is continued into the frontal sutures.

The three larval instars are nearly found all the year round, as a result of the prolonged oviposition period of the long-lived female beetles. Under controlled conditions the duration of the larval stage averages about 123 days at 25.5° C., 100 days at 28° C. and 88 days at 32° C.

The larvae occur 5-10 cm. below the surface of the soil among the plant roots. The exact depth depends upon soil moisture, the host plant and the season ; usually, during the winter, the grubs are found 15-20 cm. deep.

The larvae, when occurring in great numbers, cause serious damage below the ground to roots, stems, rhizomes and tubers of many field crops, vegetables, fruits, nursery plants and grasses. Lawns and golf-courses are the most severely infested lands, but fortunately the damage caused to field crops is light, possibly due to the presence of all the stages of development above the plough line, during approximately the whole year. Thus ploughing and other cultural processes are responsible for the great reduction in the insect population.

The full grown larva constructs for itself an elongate earthen cell 15-20 cm. deep, in which it pupates. After a short, quiescent prepupal stage, the pupa is formed within the cast-off larval skin. The epicranial suture of the moulting grub is not ruptured because the pupal head is smaller than the head of the larva. Pupation requires approximately two weeks.

The grubs and adults are preyed upon by birds such as crows, kites and egrets. Ants usually attack the eggs. The grubs are parasitised by unidentified hymenopterous larvae. Mites, fungus diseases and nematodes oftenly attack *Pentodon bispinosus* at nearly every stage of development, in the field and in rearing cages in the laboratory.

Scarabaeid beetles and their larvae, if they occurred in large numbers, they would be troublesome pests. The difficulty lies in the fact that their injury appears when control measures become too late and

of little value ; they work out of sight and their damage is sudden and quick. There are no satisfactory means of destroying white grubs that are present in large fields of growing crops, yet complaints of natives about the grub attacks are usually received a long time after cultivation.

In order to decrease the scarabaeid populations in infested lands, the following suggestions, if put under considerations, would be of great value :

(1) Ploughing and other cultural processes if worked out carefully, great numbers of the larvae and pupae would be killed or preyed upon by birds, since they are present above the plough line during nearly the whole year.

(2) Treating previously infested lands with insecticides should be adopted by applying the materials to the soil before ploughing and other cultural processes, to ensure their uniform distribution in the upper 15 cm. layer of soil.

(3) It is also important to carry out the control experiments when the insect is in an early stage of development, which appeared to be very sensitive to chemicals ; third instar larvae, on the other hand, showed a great resistance to the usual concentrations of insecticides applied to the soil insects.

IX. ACKNOWLEDGMENT

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A COMPARATIVE STUDY OF THE TOXICITY OF CERTAIN SYSTEMICS AGAINST SPIDER MITES ON COTTON

[Acarina]

(with 4 Tables)

by Drs. M. R. ABO-ELGHAR and M. S. EL-RAFIE,

Plant Protection Department, Faculty of Agriculture,

Ain Shams University.

INTRODUCTION

Systemic insecticides have been successfully used in the last ten years for the control of aphids, coccids and red spiders. These insecticides are apparently more useful and more practical for the control of such pests on seedlings for the following reasons : (1) The control of such pests with the usual contact insecticides has often presented a lot of difficulties, mainly because the plant surface in such a stage is too small to receive and retain insecticidal deposits. (2) Modern insecticides (e.g. chlorinated and phosphorus compounds) which have been successfully used for the control of suctorial insects, have the disadvantage of killing benificial insects, while the systemic insecticides are apparently non-toxic to such insects (RIPPER et AL, 1951, and AHMED et AL, 1954).

Accordingly, systemic insecticides seem to overcome such difficulties and it seems that they will soon become recommended practices in this field.

A tremendous number of reports had been forwarded by different investigators since 1950. They developed different techniques for

different pests, and studied the lasting effect of each, which is sup-
posed to be the most important factor in this aspect. Ivy et Al (1950)
soaked cotton seeds in water solution of Schradan for two hours (conc.
2, 1 and 0.5%) and found this treatment effective against spider mites
on plants in the seedling stage. Tsi (1950) used the same material in
soaking bean seeds and found the seedlings were toxic to aphids for
50 days after the treatment (concentration 0.5% for 24 hours). Dowdy
and Sleesman (1952) and Reynolds et Al (1953) used Systox success-
fully for the control of aphids, but failed to obtain good control of the
onion thrips, cyclamen mite and the white fly. David and Grinder
(1955) have shown that systemics are absorbed into the seeds in suf-
ficient quantities to give insecticidal action.

Apparently much of the early work was with Schradan, Demeton
(referred to in some references as Systox), and most reports have been
concerned with seed soaks or modifications (e.g. coating the seeds with
a suitable carrier to the insecticide such as Charcoal). Since 1954 re-
searches have been in progress with these and other systemic com-
pounds. Verma (1956) studied the effect of Demeton and Schradan on
Peregrinus maidis (leaf hopper) on maize. Several techniques for
application were tried to compare the contact toxicity of the two insec-
ticides as well as the systemic action from soaking, foliage and root
treatmeits. Reynolds and Al (1957), studied the distribution of Bayer,
Systox and Thimet within the plant, comparing the relative effect of
various methods of seed treatments (i.e. (1) 50% compound on activated
Charcaol, (2) 25% compound as an emulsion concentrate with 70%
xylene and 5% Altox 1054 A, (3) 1% compound on 30/40 mesh granular
Attaclay). The data obtained indicated little differences in the ab-
sorption of the toxicant. Dobson (1958) studied the toxic effect of
granulated systemic insecticides (Bayer 19639, Thimet and Ammonium
cyanamide 12008) on established stands of Alfalfa for the control of
the spotted Alfalfa aphid. Hanna et Al (1958) applied a number of
systemics as seed treatment for cotton plant (Demeton, Ammonium
cyanamide 12008 and 12009, Thimet and Bayer 19639). He reported
that these insecticides adequately protected young cotton plants from
thrips for a period of 4-6 weeks after the planting date.

Concerning the cotton plant, very little information has been re-
ported to compare the lasting efect of the different techniques of appli-
cation of systemics (i.e. seed treatment, foliage treatment and root
treatment). Thus, the object of this work is to explore such a prob-
lem. Moreover, a comparison between a number of systemics was
needed to choose the most convenient and applicable one.

METHODS AND MATERIALS

Five systemic insecticides were used, namely :

(1) Thimet : O, O, dietyl S-(ethylthiomethyl) phosphorodithioate.

(2) Systox : a mixture of O,O-diethyl S-ethyl-mercaptoethanol thiophosphate and its isomer, O,O-diethyl-O-ethyl-mercaptoethanol thiophosphate.

(3) Metasystox : a mixture of two isomers namely, methyl-P=S= systox (1) and methyl-P=O-Systox (2).

(4) Isopestox : bis (monoisopropylamino) flurophosphine oxide.

(5) Ekatin : Thimeton, $(CH_3O)_2$ $PSSC_2$ H_4 $SO-C_2H_5$.

Three methods for treatment or application were employed with each systemic : (1) seed treatment, (2) foliage treatment, (3) root treatment. The residual effect of the toxicants employed was determined by means of biological tests.

1. Seed treatment

For seed treatments, cotton seeds of the variety Ashmony were employed. Insecticides were applied by the soaking technique. Such a technique was found to be more convenient. Moreover, there is apparently no difference in the absorption of the toxicant by the various methods of seed treatments (REYNOLDS and al, 1957).

It was important, before soaking the seeds, to find out the most suitable concentration which does not affect the viability of the seeds.

TABLE I.

Effect of systemics used on the viability of cotton seeds soaked
for a period of 3 hours at a temperature of 25° C.

Insecticides	Mortality at concentrations of			
	2%	1.5%	1.0%	0.5%
Thimet	100	51	19	19
Systox	54	38	32	26
Metasystox	0	0	0	0
Isopestox	65	47	17	13
Ekatin	48	33	31	17

Thus, a series of preliminary experiments were carried out. Four concentrations were prepared for each material (0.5, 1.0, 1.5 and 2.0%). It was found more convenient to soak the seeds in the different concentrations of each insecticide for a definite period (3 hrs.) and at a controlled temperature (25° C.).

Germination tests were carried out according to the results of the American Association of Official Seed Analysis (1949). 200 seeds were taken at random from each treated lot and tested. The seeds were dipped in fresh water just before sowing to remove any insecticide adhering to the seed coat.

Results of viability tests are shown in Table I. The calculation of mortality was based on the number of dead seeds and the abnormal seedlings which did not show a considerable sign of normal development. For the uniformity of the data of all treatments, the percentage mortality was corrected and calculated by the usual formula :

$$C = \frac{X - Y \ (100)}{100 - Y} \qquad \text{(RICHARDSON, 1951)}$$

where X is the percentage of mortality in the treated sample and Y is the percentage of mortality in the control sample.

Accordingly, a concentration of 1% was found more convenient for the comparison test between the 5 systemics employed. Thus, seeds were soaked in the above concentration for a definite period (3 hrs.) and at a controlled temperature (25°C.). Thenafter, the seeds treated with the 5 systemics were sown in heavy soil prepared in pots under normal conditions of agriculture.

2.   Root treatments

For root treatments cotton seeds were planted in pots specially prepared for that reason and under field conditions. When the plants were about two months old, the insecticides were applied to the pots in the irrigation water. The rate was 50 ml. of the diluted material per plant. The concentration employed was 1% of each insecticide. For biological tests, leaves were taken at random from each treated plant. The first test was carried out after 24 hours from the treatment and then periodically at about weekly intervals.

3.   Foliage treatments

The same concentration of 1% of each insecticide was used for the comparative test, in spraying the leaves of cotton plants of about

two months age. Actually, such a concentration is relatively high for spraying purposes. However, 1% concentration was chosen as a base for comparing the three selected methods of applications. Plants for treatments were grown in pots specially prepared for that purpose and under field conditions. The amount of diluted material used to spray each plant was almost the same (about 50 ml.). Spraying took place by means of a hand sprayer. A special technique was adopted to prevent contamination of the soil in the pots by the insecticide solution. The toxic effect of the directly sprayed leaves was tested after 24 hours from the treatment and then periodically at about weekly intervals.

Biological tests

Laboratory studies were carried out to determine the comparative toxicity and the lasting effect of the 5 systemics used. The test animal used in all the biological tests was the two-spotted spider mite, *Tetranychus bimaculatus* Harvey. Animal colonies of mites were established in the laboratory on cotton plants. Toxicity tests were conducted as follows :

The treated leaves prepared for tests were placed in Petri dishes on wet cotton-wool. Such a technique serves to keep the tested mites confined to the leaves. Thenafter, an infested half-leaf with the test animal was placed on each treated leaf. These source leaves were removed a day after, and since by that time they were almost dry, practically mites of all stages had then been transferred to treated moist leaves. Ideally, by such a technique, 75-100 adult females would transfer to each treated leave.

The tested mites were then allowed to remain on the treated leaves for another two days before being counted. Therefore, the mites were almost in contact with the treated leaves for periods ranging from 48-72 hours before counting of mortality took place. During this period, the mites were kept in a well-ventilated room in which the temperature ranged between 27-32° C.

For the purpose in hand, only the adult females were considered in the process of counting the percentage mortality. Animals were considered dead if they could not move forward after being proded by a dissecting needle. The percentage mortality was based on the total number of dead and alive female mites present on both surfaces of the treated leaf. Four replications from each treatment were used and controls were always maintained.

RESULTS

Results obtained in the biological tests are shown in Tables II, III and IV. They represent the percentage mortality of the common red spider mite, *Tetranychus bimaculatus* Harvey, in relation in number of hours and days after the different applications of systemics (i.e. seed treatments, root treatments and foliage treatments, respectively). In other words, the toxicity of the systemics used to the red spider was evaluated.

It should be mentioned here that in the case of seed treatments, toxicities were tested on both the cotyledons and the first two leaves (true leaves). The latters began to show up after about 45 days from planting. In other treatments, toxicities were tested on leaves taken at random from the treated plants.

For investigating the relationship between the dose of the systemic applied to the seeds and its resultant toxicity to mites, two different concentrations were employed with Metasystox (i.e. 1 and 2%). Metasystox was chosen for such an investigation as it was the only material which did not show any apparent injurious effect on the viability of the seeds under such a high concentration.

DISCUSSION

1. Seed treatments

Data in Table II indicate the lasting effect of systemics in the cotyledons and the first true leaves, when applied to the seeds. Results show clearly that Thimet 44-D was considerably more toxic for 44 days than any other material tested. A moderate kill was obtained with Systox. However, Metasystox, Isopestox and Ekatin gave comparatively an inferior kill (e.g. the percentage mortality after 10 days was 15, 14 and 6%, respectively, while with Thimet and Systox it was 100 and 90%, respectively).

The effect of increasing the dose on the toxicity was clearly manifested with Metasystox. It is quite apparent that the toxicity is increased as the dosage was increased. The percentage mortality was 15, 10 and 7% with 1% concentration after 10, 30 and 40 days, respectively, while with 2% concentration, it was 50, 40 and 10%, respectively.

TABLE II.

Mortality of the two spotted spider mite Tetranychus bimaculatus *Harvey exposed on cotton leaves after seed treatment with systemic insecticides.*

Insecticides	Conc. %	Percentage mortality (in days) of mites after			
		10	30	45*	
				A	B
Thimet 44-D	1	100	90	83	30
Systox	1	91	56	28	11
Metasystox	1	15	10	7	2
Metasystox	2	50	40	10	0
Isopestox	1	14	10	8	4
Ekatin	1	6	0	0	0
Control	—	0	0	0	0

* Days after planting: A, on cotyledons; B, on first true leaves.

When it comes to the effect of seed treatments with systemics on the toxicity in the true leaves (e.g. the first two leaves), the picture is completely different. It is of interest to find out that all the systemics tested has shown a sudden drop in toxicity when they reached the first true leaf. Such a fact was clearly manifested in the comparison test between the cotyledons and the first true leaves which appeared 45 days after planting. With Thimet, the percentage mortality was 83% on the cotyledons while it was only 30% on the first leaf. The rest of the systemics have shown almost a similar behaviour. Such a phenomenon indicates that the greater part of the toxicant material absorbed in the seed is accumulated in the cotyledons. Moreover, the active material is not subsequently translocated to the true leaves in substantial amounts. Thus the toxicant apparently exists in the plant in a considerable concentrations gradient ranging from the highest value in the oldest leaves to the lowest in the youngest leaves. Consequently, as the plant gets older, the systemics are reduced in the plant sap until it gets to the point that they disappear. Such a finding was noticed as well by REYNOLDS et AL (1957).

2. Root treatments

Data in Table III illustrates the toxicity of the systemics used against spider mites when applied to the roots of cotton plants. It can

be seen clearly that all the materials tested gave an excellent control for 7 days from application. However, while Ekatin and Isopestox began to loose their effectiveness after 20 days from application, Thimet and Systox lasted effectively for 40 days and Metasystox gave a good control for 30 days from application.

TABLE III.

Mortality of the two spotted spider mite Tetranychus bimaculatus *Harvey exposed on cotton leaves after root treatment with systemic insecticides at the rate of 50 ml. per plant.*

Insecticides	Conc. %	Percentage mortality (in days) of mites after						
		2	7	20	25	32	41	50
Thimet 44-D	1	98	93	87	86	80	70	55
Systox	1	100	100	96	96	85	71	50
Metasystox	1	98	95	90	83	73	45	14
Isopestox	1	98	86	53	27	16	9	0
Ekatin	1	100	94	55	49	17	6	0
Control	—	0	0	0	0	0	0	0

We should emphasize here the fact that the translocation of the active materials to the new growth was appreciably in a higher rate when systemics are applied to the roots. But when systemics applied to the seeds, the active material was apparently accumulated in the endosperm and consequently translocated to the plumule (cotyledons) and radicle. The root system in this early stage is apparently very poor to accomplish the translocation process of the active material throughout the new vegetative growth. Moreover, in the root treatment application, the longevity of the toxicant material in the vegetative growth could be attributed to the fact that the quantity of the active material absorbed by the root is no doubt larger than that absorbed by the seed.

3. Foliage treatments

Data in Table IV illustrates the toxicity of the systemics used against spider mites when applied to the vegetative shoot by a hand sprayer. A general study of the Table indicates that Thimet 44-D gave

the best results for 30 days from spraying, followed by Systox which gave good control for 12 days. The rest of the materials tested apparently lost their effectiveness within a week from application.

TABLE IV.

Mortality of the two spotted spider mite Tetranychus bimaculatus *Harvey exposed on cotton leaves sprayed with systemic insecticides at the rate of 50 ml./plant.*

	Conc. %	Percentage mortality (in days) of mites after				
		1	7	12	21	30
Thimet 44-D	1	95	82	80	72	60
Systox	1	100	57	53	21	0
Metasystox	1	96	36	25	6	0
Isopestox	1	63	11	8	0	0
Ekatin	1	76	33	18	2	0
Control	—	0	0	0	0	0

The fact that systemics lost their toxicity in foliage treatments so much earlier than they did on either seed or root treatments could be explained. The quantity of systemics absorbed by the leaves after spraying is apparently at a lower rate than that absorbed in root or seed treatments. This might be due to the fact that sprayed leaves were well developed by the time of spraying. These results are in agreement with those obtained by HEATH et AL (1952). They showed that systemics are taken up into the leaf from a spray deposit at a rate very much dependent on the state of growth. The seedlings absorb much faster than old leaves which become non-absortive late in the season.

PHYTOTOXICITY

It is of interest to note the phytocidal effects of each material used at 1% concentration in this study under the different techniques of treatments employed.

1. Seed treatments

Thimet have shown to be the most toxic material to the viability of the seeds. Moreover, it reduced the seedling stands and reduced

growth during the early part of the season. Other materials tested seemed to stimulate growth during that very period. However, as plants has grown up, 2 to 3 months old, there was hardly any apparent difference on the development of old treated plants.

2. Root treatments

In root treatments, Thimet 44-D and Systox were more injurious than any of the other materials. Plants treated with Thimet had shown an acute type of damage within few days from treatment. The damage took the form of a severe burning of tips and margins of the leaves and formed necrotic patches in the intervening tissue. New developed leaves showed at first the same symptoms but as it aged it looked normal. Moreover, the plants were generally in a rather weaker condition compared with the untreated plants. However, 3-4 weeks following treatment, plants almost recovered and there was hardly any apparent difference. Plants treated with Systox showed a very similar type of injury which was rather more severe. However, plants recovered in the same way. Nevertheless, Metasystox, Isopestox and Ekatin did not show any apparent sign of phytotoxicity. Treated plants looked quite normal.

3. Foliage treatments

Almost all materials used showed different types of injury on sprayed leaves. With Thimet, injury to foliage first appeared as a wilting of the tissues within two days from spraying. This was followed by the burning of the edges of the leaves. However, the plants recovered and looked almost quite normal two weeks from treatment. Systox was apparently more injurious in these treatments. The plants showed an acute type of injury in the form of the wilting of the leaves in the first few days. This was followed by necrotic patches in the intervening tissues similar to that noticed in the root treatment. However, in the new growth which developed after the treatment, leaves were free from injury. Three weeks after treatment plants recovered and looked normal.

Metasystox was strangely more injurious in this treatment than in the root or seed treatments. Plants were apparently quite normal within the first few days after the spraying. However 6-7 days later the injury appeared in the whole plants as a general wilting. This was

followed by the browning of the tissues. Three weeks from treatment, the plants recovered and looked quite normal. Isopestox was apparently less injurious. The only symptoms of injury noticed was the burning of the tips and edges of the leaves. Plants were almost quite normal within 10 days from spraying. Plants treated with Ekatin did not show any apparent sign of phytotoxicity.

SUMMARY

Experiments were conducted to determine the toxicity of 5 systemic insecticides (i.e. Thimet, Systox, Metasystox, Isopestox and Ekatin) to spider mites on cotton plants. Three different methods of application were used (i.e. seed treatments, root treatments and foliage treatments). Toxicity was determined biologically using the common red spider, *Tetranychus bimaculatus* Harvey, as a test animal.

Total results obtained suggest that :

(1) Cotton seeds soaked in a solution of 1% Thimet 44-D for three hours at 25° C. give full protection to cotton seedlings against early pests for 45 days. Systemics are translocated mainly into the cotyledons and partially into the first true leaves.

(2) In seed treatments, the effect of increasing the dose on the toxicity was clearly demonstrated with Metasystox. The higher the dose, the greater the toxicity.

(3) Root treatments gave the highest toxicity in new growths compared with other methods of application.

(4) Thimet 44-D, under the comparative concentration employed in the three methods of application, had shown to be the leading material followed by Systox. However, in root treatments, Thimet and Systox gave almost the same toxicity.

(5) Results obtained in foliage treatments indicate that the toxicity of systemic insecticides employed could be attributed to their contact action more than to systemic action.

(6) A correlation between the phytotoxicity of the systemic insecticides employed and their toxicity to insects had been observed. Thimet had shown to be almost the most injurious material. Other materials gave different degrees of injury. However, almost complete recovery had occurred after varying periods from applications.

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A PRELIMINARY SURVEY OF THE INSECT FAUNA
OF SAUDI ARABIA

by FATHY SHALABY,

Delegate of the Entomological Section (Ministry of Agriculture, Cairo)
to the Ministry of Agriculture in Saudi Arabia.

INTRODUCTION

The Saudi Arabia Department of Agriculture became a Ministry only in 1954 and the set up of the Ministry comprised a Section for Plant Protection, the main task of which was to start a survey of the insect fauna of the Country. Except for a few collection made by casual visitors, no such survey was made prior to January 1956.

In the absence of a library and a reference collection, the task was quite arduous. Now, after four years of hard work under the most difficult conditions, it is possible to publish the list of the insects which actually exist in the collections of the Saudi Ministry of Agriculture, the nucleus of a reference collection which, it is hoped, will be gradually enlarged by continued additions in an endeavour to make a more comprehensive survey. In the present nomenclature all genera are recorded alphabetically for each family and sub-family, together with the distribution of the species throughout the Country, data, host plants or other information when available.

It would never have been possible to carry out this work without foreign assistance. Through the courtesy of Mr. D.J. WILLIAMS, the Director of the British Museum (Natural History), I could deal with the different sections of the Museum in the identification of many specimens ; Mr. P.W. OMAN, Director of the Insect Identification and Parasite Introduction Laboratories (Maryland, U.S.A.), obliged me with the naming of many species as well ; Professor CH. NOIROT, of the Faculté des Sciences de Paris, has kindly identified the termites for

us ; Mr. A. Alfieri, Secretary General of the Entomological Society of Egypt, took much interest in our work and offered valuable help and assistance in the identification of a large number of species ; Mr. Abd El Megid El Mistikawy, Plant Protection Expert and the representative of Food and Agriculture Organization in Saudi Arabia Kingdom, helped and encouraged me all along my work. I wish to express my thanks and gratitude to all these scientists for the trouble they took in helping me to carry out my task. Without such help I am sure I would have not been able to achieve my aim.

THYSANURA

Lepismidae

Thermobia aegyptiaca Luc. : Djedda, in house, 25.xii.58 ; Riyad, in houses, 26.viii.57, 28.ii.60.

ORTHOPTERA

Blattidae

Periplaneta americana L. : Djedda, in houses, 17.iii.56, 14.iv.56, 19.v.56, 12.vi.56 ; Taif, in houses, 16.ii.58. — *Phyllodromia germanica* L. : Djedda, in houses, 17.iii.56, 4.vii.56.

Mantidae

Blepharis (Blepharopsis) mendica Fab. : Shakra, on citron, 8.ix. 57 ; Medina, on the soil, 26.iii.1958. — *Sphodromantis bioculata* Burm. : Djedda, 26.viii.56 ; Shakra, on citron, 8.ix.57 ; Gizan, 5.iii.58 ; Medina, 24.iii.58. — *Taracodes* sp. : Djedda, 20.viii.56.

Tettigoniidae

Diogena fausta Burm. : Medina, at lamp light, 12.xi.57. — *Enconocephalus varius* Walk., Wadi Kadid, 8.x.56. — *Phaneroptera sparsa* St., Medina, at lamp light, 10.vi.57 and on vegetables, 26.iii.58.

Gryllidae

Gryllotalpa gryllotalpa cophta de Haan : Taraba, on the soil, 18.iii.58 ; Medina, on turnip roots, 3.i.57 ; Goaf, on potato roots,

25.i.60. — *Gryllus domesticus* L. : Djedda, in houses, 3.vii.56. — *Gryllus* sp. : Gizan, on the soil, 5.iii.58. — *Liogryllus bimaculatus* de Geer : Medina, on the soil, 12.vi.57.

Acridiidae

Acrida (= Tryxalis) nasuta L. : Djedda, 19.iv.56, 4.v.56 ; Riyad, 25.viii.57, 22.x.57, 2.ix.57 ; Gizan, 5.iii.58 ; Medina, 26.iii.58. — *Acrotylus insubricus* Scop. : Djedda, 26.viii.56. — *Aiolopus strepens* Latr. : Riyad, 21.xi.56. — *Aiolopus thalassinus* F. : Riyad, 21.xi.56, 28.viii.57. — *Anacridium aegyptium* L. : Djedda, 8.viii.56 ; Riyad, 22.xi.56, 2.xii. 56, 19.ii.57, 26.iii.57, 23.ii.58 ; Gizan, 5.iii.58. — *Caloptenopsis glaucopsis glaucopsis* Walk. : Gizan, 5.iii.58. — *Catantops axillaris axillaris* Thunb. : Gizan, 5.iii.58. — *Chrotogonus homalodemus* Blanch. : Gizan, 3.iii.58 ; Taif, 16.iii.58. — *Chrotogonus lugubris* Blanch. : Wadi Kadid, 16.x.56. — *Cyrtacanthacris tatarica tatarica :* Gizan, 5.iii.58. — *Duronia tricolor* Karny : Gizan 5.iii.58. — *Gastrimargus africanus* Sauss. : Gizan, 5.iii.58. — *Morphacris fasciata* Thunb. : Riyad, 10.x.57. — *Ochrilidia* sp. : Djedda, 3.iv.56 ; Riyad, 10.x.57. — *Oedaleus senegalensis* Kr. : Gizan, 5.iii.58. — *Oedipoda miniata* F. : Riyad, 3.v.56. — *Poecilocerus bufonius* K. : Medina, 14.ii.56 ; Djedda, 20.viii.56 ; Riyad, 26.viii.56, 1.xii.56, 20.iii.57, 18.iv.57, 10.ix.57, 17.xi.57, 5.iii.58, 6.vii.58. — *Pycnodicta dentata* Kr. : Taif, 8.x.56. — *Shistocerca gregaria* Forsk.: Djedda, 8.iii.56, 8.v.59, 13.i.60 ; Riyad, 5.iv.56, 12.ii.58. — *Sphingonotus rubescens* Walk. : Djedda, 16.x.56. — *Sphingonotus savignyi* Serv. : Riyad, 2.vi.56. — *Thisoicetrus littoralis* R. : Riyad, 21.xi.56.

DERMAPTERA

Forficulidae

Anisolabis (Euborellia) annulipes L. : Djedda, 17.iii.56 ; Riad, 14. viii.57. — *Forficula auricularia* Linné : Taif, 15.iii.58. — *Labidura (Forficula) riparia* Pallas : Riyad, 20.x.58, 14.xii.58.

ISOPTERA

Hodotermitidae

Anacanthotermes ochraceus Burm. : Wadi Khulais, on dry wood, 22.xi.58 ; Medina, on wood in house, 30.i.59.

· Termitidae

Microcerotermes diversus Silv. : Riyad, in apple tree roots, 21.ix.
57, 17.xi.57, 12.viii.58, 14.ix.58, 3.v.59 ; Mecca, in she-oak tree roots,
15.xi.58, 14.xii.58, 1.iv.59 ; Gizan, in great millet roots, 4.iii.58 ; Abha,
under stones, 4.iii.59 ; Djedda, in she-oak tree roots, 19.xi.58, 21.ix.59 ;
Wadi Kulais, in pomegranate tree roots, 24.xi.58.

Rhinotermitidae

Psammotermes fuscofemoralis Sjösted : Wadi Khulais, in dry
wood, 23.xi.58.

ODONATA

Libellulidae

Crocothemis erythraea Brullé (male) : Medina, 26.iii.58. — *Sym-
petrum fonscolombei* Selys (male) : Medina, 24.iii.58. — *Orthetrum
sabina* (male) : Mecca, 4.iii.56 ; Djedda, 19.iv.56, 20.viii.56. — *Orthe-
trum trinacria* Selys : Riyad, 22.viii.57 ; Djedda, 3.iv.56.

Aeschnidae

Hemianax ephippiger Burm. : Djedda, 11.iii.56.

Agrionidae

Ischnura senegalensis Ramb. : Riyad, 2.xii.56.

HEMIPTERA HETEROPTERA

Cydnidae

Cydnus pilosus H.-S. : Gizan, 6.iii.58.

Pentatomidae

Anchesmus ruficornis Stål. : Mecca, 4.iii.56. — *Aspongopus vidua-
tus* F., always found on cucurbitaceous plants : Riyad, 19.iv.56, 27.vii.
56, 27.ix.56, 23.viii.58, 4.v.59, 19.viii.59 ; Djedda, 20.v.56, 24.xi.58,
17.xii.58, 1.iv.59 ; Wadi Khulais, 1.iv.56, 12.vii.59 ; Gizan, 3.iii.58 ;
Magmaa, 17.viii.57 ; Taraba, 28.ii.59 ; Bisha, 15.iii.59 ; Taif, 7.ix.59,

11.x.59, 8.xi.59, 6.xii.59, 12.i.60 ; Al Harik, 12.viii.59 ; Tabouk, 21.viii.
59 ; Medina, 20.xi.58, 17.v.59, 4.ix.59, 17.x.59 ; Mecca, 8.xii.59. — *Bra-chynema virens* Klug : Djedda, in house, 15.iv.56. — *Dorpius cribrosus*
Klug : Gizan, 5.iii.58. — *Eusarcoris inconspicuus* H.-S. : Riyad, 6.x.57.

Coreidae

Stenocephalus pallidus Sign. : Djedda, 7.iii.56, 18.iv.56.

Pyrrhocoridae

Scantius aegyptius L. : Riyad, 22.viii.57.

Myodochidae (Lygaeidae)

Dieuches syriacus Dohrn., on pomegranate fruits : Medina, 13.ii.
56 ; Riyad, 1.v.56. — *Oxycarenus hyalinipennis* Costa : Riyad, on okra,
17.xii.58 ; Riyad, on cotton, 29.xii.59 ; Gizan, on cotton, 3.iii.58 ; Bisha,
on cotton, 15.iii.59. — *Spilostethus pandurus militaris* F. : Djedda,
20.viii.56.

Miridae

Creontiades pallidus Ramb. : Mecca, 4.iii.56. — *Engytatus* sp. :
Riyad, on tomato, 2.ix.58.

HEMIPTERA HOMOPTERA

Cicadidae

Tettigia orni L. : Djedda, on she-oak tree *(Casuarina)*, 20.viii.56.

Coccidae

Aonidiella orientalis Newst. : Riyad, on citrus, 27.i.58, 11.ix.58,
20.xi.58, 4.v.59, 5.xii.59, 3.i.60 ; Riyad, on *Ficus* sp., 18.vi.58, 14.
viii.59 ; Riyad, on olive leaves, 25.i.59, 3.i.60 ; Riyad, on rose
leaves, 13.x.59 ; Riyad, on white mulberry leaves, 3.i.60 ; Riyad,
on oleander leaves, 13.x.59 ; Riyad, on banana tree leaves, 27.xii.59 ;
Abha, on citrus leaves, 9.iii.59 ; Mecca, on citrus leaves, 18.xii.58 ;
Alkharg, on citrus leaves, 24.xii.59, 14.i.60 ; Taif, on citrus leaves,
7.ii.60 ; Hail, on citrus leaves, 11.viii.59 ; Hufouf, on *Citrus medica,*

12.i.60, 12.ii.60 ; Hufouf, on citrus leaves, 1.xii.59, 11.i.60, 13.ii.60 ;
Djedda, on citrus leaves, 13.xi.58, 23.xii.58 ; Djedda, on rose trees,
26.xi.58, 2.xii.58, 12.ii.59, 29.iv.59, 6.v.59, 5.ix.59, 30.x.59, 4.xi.59 ;
Djedda, on guava trees, 29.xi.58, 6.xii.58, 7.i.59, 12.ii.59, 1.iii.59, 8.vii.
59, 5.ix.59, 6.x.59, 1.xi.59, 6.xii.59, 12.i.60. — *Aspidiotus hederae* Vallot:
Taif, on oleander leaves, 15.iii.58. — *Asterolecanium sambuci* Ck. :
Djedda, on fig trees, 25.vii.59, 22.xii.59 ; Djedda, on oleander trees,
27.xi.57, 9.xii.58, 1.iii.59 ; Djedda, on mango trees, 23.xii.58, 5.ii.59,
8.iii.59. — *Crytoparlatoreopsis meccae* Hall : Medina, on nabk trees
(*Zizyphus* sp.), 14.v.56. — *Chrysomphalus ficus* R. : Taraba, on citrus
leaves, 18.iii.58, 28.ii.59, 20.i.60. — *Icerya purchasi* Mask. : Taraba, on
citrus leaves, 27.ii.59, 21.i.60 ; Abka, on citrus leaves, 2.iii.59 ; Taif,
on citrus leaves, 22.iii.59, 14.i.60, 16.ii.60 ; Taif, on *Acacia* sp., 24.
iii.59 ; Taif, on poetry jasmine, 24.iii.59 ; Medina, on fig trees,
24.viii.58 ; Medina, on grape vine trees, 30.vi.59, 10.vii.59, 15.xi.58 ;
Djedda, on citrus trees, 15.ii.58, 21.xii.58, 8.i.59, 5.ii.59, 18.iii.59, 21.
vii.59, 29.xii.59, 13.i.60, 8.ii.60 ; Djedda, on guava trees, 23.xi.58,
22.xii.58, 15.iii.59, 25.vii.59, 24.xii.59, 3.i.60, 9.ii.60 ; Djedda, on fig
trees, 13.xi.58, 29.xii.58, 14.i.59, 5.ii.59, 9.iii.59, 20.vii.59, 19.xii.59,
11.i.60 ; Djedda, on mulberry trees, 22.xi.58, 5.ii.59, 28.iii.59 ; Djedda, on
pomegranate trees, 14.i.59, 18.i.60 ; Djedda, on henna plants (*Lawsonia*
sp.), 11.i.59, 14.ii.59 ; Djedda, on *Lantana,* 29.xi.58, 25.xii.58, 4.ii.59,
18.iii.59, 20.vii.59, 3.viii.59, 30.xi.59, 30.xii.59, 11.i.60. — *Lecanodiaspis*
africana Newst. : Riyad, on fig trees, 25.ii.57, 6.x.58. — *Lepidosaphes*
ulmi L. : Djedda, on apple trees, 24.ix.59. — *Naicoccus serpentinus*
minor G. : Biraida, on tamarisk trees, 26.vi.56. — *Nipaecoccus vestator*
Mask. : Riyad, on oleander leaves, 16.xii.58 ; Riyad, on citrus leaves,
20.xii.58. — *Parlatoria blanchardi* Targ. (always on date palm trees) ;
Taraba, 27.ii.59 ; Bisha, 14.iii.59 ; Al Akik, 20.iii.59 ; Al Goaf, 25.vii.56 ;
Al Kharg, 27.xi.59, 24.xii.59 ; Tabouk, 21.viii.58, 5.ix.58 ; Al Ola, 6.xii.
59 ; Hail, 21.i.60 ; Medina, 8.ii.59 ; Djedda, 28.iii.59, 1.iv.59, 9.ii.60. —
Parlatoria morrisoni Mck. : Riyad, on oleander leaves, 9.viii.58. —
Parlatoria oleae Colv. : Djedda, on olive trees, 5.i.59 ; Abka, on olive
trees, 7.iii.59. — *Phenacaspis* sp. : Medina, on nabk trees (*Zizyphus*
sp.), 25.iii.58. — *Pinnaspis strachani* C. : Djedda, on citrus trees, 7.iii.
56, 13.xi.58, 8.xii.58, 7.i.59, 4.ii.59, 9.iii.59, 23.iv.59, 8.vii.59, 12.ix.59,
21.x.59, 1.xi.59, 14.xii.59, 3.i.60 ; Djedda, on *Croton* sp., 24.ix.59 ; Djed-
da, on fig trees, 13.xi.58, 15.xii.58, 29.iv.59 ; Djedda, on poetry jasmine,
31.x.59. — *Pseudococcus citri* Risso : Djedda, on *Croton* sp., 24.ix.59. —
Pulvinaria floccifera Westw. : Djedda, on guava trees, 21.xi.58. —
Rugaspidiotus tamaricicola Mal. : Hail, on tamarisk trees, 28.vii.58.

Aleyrodidae

Aleurolobus niloticus Pr.-Hosni : Riyad, on citrus trees, 27.i.58. — *Dialeurodes kirkaldyi* Kot. : Riyad, on Arabian jasmine leaves, 9.viii. 59 ; Djedda, on Arabian jasmine leaves, 13.xi.58, 8.xii.58, 7.i.59, 7.ii.59, 9.iii.59, 21.iv.59, 5.v.59, 3.vii.59, 5.ix.59, 8.x.59, 5.i.60. — *Siphoninus granati* Pr.-Hosni : Medina, on pomegranate leaves, 8.i.59 ; Djedda, on pomegranate leaves, 17.xii.57.

Aphididae

Aphis ? fabae Scop. : Riyad, on poetry jasmine, 20.xii.58. — *Aphis durantae* Theo. (= *punicella* Theo.) : Djedda, on pomegranate trees, 24.viii.58, 3.x.58, 23.xi.58, 23.xii.58, 4.ii.59, 9.iii.59, 30.iv.59, 2.v.59, 1.x.59, 1.xi.59, 24.xii.59, 18.i.60. — *Aphis laburni* Kalt. : Medina, on broad bean leaves, 3.i.57. — *Aphis maidis* Fitch. : Gizan, on great millet leaves, 6.iii.58 ; Bisha, on great millet leaves, 15.iii.59 ; Medina, on great millet leaves, 2.i.57. — *Aphis ? nerii* B.D.F. : Riyad, on olean-der leaves, 20.vi.58 ; Riyad, on Euphorbiaceae, 28.xii.58. — *Brevicoryne brassicae* L. : Taraba, on cabbage, 27.ii.59 ; Abha, on cabbage, 8.iii.59 ; Abha, on turnip leaves, 8.iii.59 ; Medina, on cabbage, 20.ii.57 ; Riyad, on cauliflower, 30.xi.59, and on Euphorbiaceae, 28.xii.58. — *Eriosoma lanigera* Hausm. : Riyad, on apple trees, 27.i.58, 5.vi.58, 10.xi.58, 2.xii. 58, 15.ii.59, 29.iv.59, 18.xii.59.

NEUROPTERA

Chrysopidae

Chrysopa vulgaris Schn. : Taraba, on lemon tree, 28.ii.59 ; Riyad, at lamp light, 10.xii.56.

Myrmeleonidae

Cueta variegata Klug : Djedda, at lamp light, 2.viii.56 ; Riyad, at lamp light, 15.ix.57.

LEPIDOPTERA

Satyridae

Ypthima asterope Klug : Gizan, 6.iii.58.

Danaidae

Danais chrysippus L. : Djedda, on vegetables, 8.iii.56, 3.iv.56, 14. x.56 ; Medina, on vegetables, 5.xii.56.

Nymphalidae

Precis hierta F. : Gizan, 6.iii.58. — *Precis oenone* L. : Gizan, 6.iii. 58 ; Medina, 24.iii.58. — *Vanessa (Pyrameis) cardui* L. : Djedda, 8.iii. 56 ; Riyad, 2.xi.57.

Lycaenidae

Cosmolyce (Polyommatus) baeticus L. : Djedda, on broad bean, 8.iii.56 ; Medina, on common pea, 10.ii.57. — *Deudorix (Virachola) livia* Klug : Medina, on pomegranate, 3.ix.56 ; Taif, on pomegranate, 23.iii.59 ; Riyad, on pomegranate, 3.i.60 ; Kurait El Malh, on pomegranate, 12.x.59. — *Lycaenesthes* sp. : Gizan, 3.iii.58. — *Taracus theophrastus* F. : Gizan, 6.iii.58 ; *Zizeeria knysna* Trim. : Taif, 17.iii.58.

Pieridae

Anaphaeis aurota F. : Riyad, 2.xi.57 ; Gizan, 5.iii.58 ; Taif, 17.iii. 58 ; Medina, 25.iii.58. — *Catopsilia florella* F. : Djedda, 8.iii.56. — *Catopsilia* sp. : Djedda, 8.iii.56, 14.x.56. — *Colias croceus* Fourc. : Riyad, 12.x.57. — *Colias electo croceus* F. : Taif, 15.iii.58. — *Colotis danae* F.: Medina, 26.iii.58. — *Colotis phisadia* Gtd. : Medina, at lamp light, 26. iii.58. — *Colotis* sp. : Gizan, 5.iii.58. — *Eureme hecabe* L. : Medina, 24.iii.58 ; Gizan, 3.iii.58. — *Pieris rapae* L. : Riyad, on cabbage, 26.iii. 57 ; Al Kharg, on snake cucumber, 28.x.58. — *Pontia glauconome* Klug: Gizan, 1.iii.56, 5.iii.58 ; Riyad, 4.v.56, 12.x.57, 2.xi.57 ; Taif, 16.iii.58 ; Medina, 25.iii.58 — *Taracolus fausta* Ol. : Riyad, 12.x.57, 2.xi.57 ; Medina, 25.iii.58.

Papilionidae

Papilio demoleus L. : Medina, on citrus leaves, 3.iv.56, 7.xi.56, 24.iii.58 ; Djedda, on citrus leaves, 1.iii.56 ; Riyad, on citrus leaves, 7.xi.56, 10.xii.56, 27.ii.57, 7.iii.57, 22.viii.57, 26.ix.57, 12.x.57, 27.i.58, 6.vii.58, 10.ix.58, 30.x.58, 16.viii.59, 16.ix.59, 10.x.59.

Hesperidae

Pelopidas borbonica zelleri Led. (*Parnara mathias* F.) : Djedda, on vegetables, 1.iii.56 ; Riyad, on vegetables, 26.ix.57.

Lasiocampidae

Chondrostega sp. : Riyad, on wild plants, 10.ii.58.

Sphingidae

Hippotion (Chaerocampa) celerio L. : Medina, at lamp light, 1.iii.56 ; Riyad, on grape-vine trees, 16.ix.57, 12.x.57 ; Houfuf, on grape-vine trees, 29.i.58. — *Deilephila (Daphnis) nerii* L. : Medina, at lamp light, 21.v.57 ; Riyad, on oleander, 28.x.57. — *Celerio (Deilephila) lineata livornica* Esp. : Medina, at lamp light, 1.iii.56, 26.iii.58. — *Herse convolvuli* L. : Medina, at lamp light, 14.iv.57, 21.v.57.

Agrotidae

Agrotis saracenica Tams. : Medina, at lamp light, 21.v.57. — *Agrotis ypsilon* Rott. : Medina, on turnip, 3.i.57 ; Taif, on alfalfa, 15. iii.58 ; Goaf, on alfalfa, 25.i.60. — *Anua tirhaca* Cr. : Medina, on guava leaves, 20.ii.57. — *Anumeta* sp. near *spilota* Ersch. : Riyad, at lamp light, 29.x.57. — *Autophila cerealis* Staud. : Medina, 22.iii.58. — *Chalciope hyppasia* Cram. : Medina, at lamp light, 26.iii.58. — *Chloridea obsoleta* F. (*Heliothis armigera* Hubn.) : Riyad, on tomato, 14.xii.56 ; Medina, on kidney beans, 20.xii.56 ; Medina, on broad beans, 20.ii.57 ; Tabouk, on tomato, 30.vii.58. — *Chloridea (Heliothis) peltigera* Schiff.: Medina, on tomato, 19.xii.56. — *Cortyta rosacea* Rebel : Medina, at lamp light, 21.v.57. — *Cucullia* sp. near *syrtana* Mab. : Medina, at lamp light, 26.iii.58. — *Earias insulana* Boisd. : Medina, on okra, 24.xi.56 ; Riyad, on okra, 7.xi.57, 28.ix.57. — *Laphygma exigua* Hb. : Medina, on alfalfa, 23.xi.56, 30.v.58, 2.vi.59, 12.vii.59, 20.ix.59, 7.x.59 ; Medina, on common lettuce, 11.i.57 ; Djedda, on alfalfa, 25.xii.58, 7.ix.59 ; Djedda, on tomato, 10.ii.59, 30.i.60, 1.ii.60 ; Djedda, on vegetable marrow, 30.i.60 ; Hail, on alfalfa, 26.ix.59, 25.x.59, 25.xi.59 ; Taif, on cabbage, 13.ix.59 ; Taif, on alfalfa, 25.x.59 ; Mecca, on cabbage, 15.ii.58, 30.xi.58 ; Mecca, on alfalfa, 9.vii.59, 26.ix.59 ; Tabouk, on alfalfa, 27. vii.58, 3.ix.59. — *Leucania* sp. near *phaeopasta* Hmp. : Riad, at lamp light, 29.x.57. — *Ochropleura (Dichagyris) imperator* Bang-Haas : Medina, at lamp light, 21.v.57, 26.iii.58. — *Ophiusa algira* L. : Medina, at lamp light, 21.v.57. — *Pandesma robusta* Walk. : Djedda, at lamp light, 18.viii.56 ; Medina, at lamp light, 26.iii.58. — *Parallelia torrida* Guen. : Riyad, at lamp light, 4.x.57. — *Phytometra circumflexa* L. : Medina, on turnip, 3.xi.56. — *Phytometra daubei* Boisd. : Medina, on turnip, 3.xi.56. — *Phytometra ni* Hb. : Riyad, 14.xii.56 ; Medina, 19.

vii.58. — *Prodenia litura* F.: Medina, on alfalfa, 19.ii.57, 11.xii.58, 28.ix.59, 5.x.59. — *Pseudohadena* sp. near *roseonitens* Ob.: Medina, at lamp light, 26.iii.58. — *Sesamia cretica* Led.: Medina, on great millet, 28.vii.56, 3.ii.57; Medina, on common wheat, 13.ii.57; Bisha, on great millet, 15.iii.59. — *Spodoptera cilium* Guen.: Riyad, on Bermuda grass, 14.x.57. — *Tathorhynchus exsiccata* Led.: Medina, at lamp light, 21. v.57. — *Ulotrichopus stertzi* Pung.: Medina, at lamp light, 26.iii.58. — *Xanthodes graellsii* Feisth.: Medina, at lamp light, 21.v.57.

Lymantriidae

Casama impura Hering: Medina, 26.iii.57.

Arctiidae

Eogocera rectilinea Boisd.: Gizan, 5.iii.58. — *Utethiesa pulchella* L.: Riyad, on vegetables, 4.v.56, 22.viii.57, 12.x.57; Medina, on henna plants, 24.iii.57; Djedda, on henna plants, 4.xii.57, 4.xii.58, 9.xii.59.

Cossidae

Eremocossus reibellii Oberth.: Medina, at lamp light, 21.v.57. — *Cossus* sp.: Medina, at lamp light, 21.v.57.

Pyralidae

Arenipses sabella Hmps.: Kwiia, on date palm trees, 21.iv.57. — *Cornifrons ulceratalis* Led.: Riyad, 2.xii.56. — *Ephestia* sp.: Medina, on date palm trees, 25.iii.58. — *Ephestia* sp.: Bisha, on date palm, 14. iii.59. — *Heterographis samaritanella* Zell.: Riyad, 3.xi.56. — *Noorda* sp. near *amethystina* Swinh.: Djedda, on henna plant, 19.viii.56.

Tineidae

Meharia semilactea Warr.: Medina, at lamp light, 21.v.57.

Gelechiidae

Platyedra gossypiella Saund.: Gizan, on cotton bolls, 11.iii.58.

Gracilariidae

Phyllocnistis citrella St. (the citrus leaf-miner): Riyad, 27.i.58, 4.v.59, 13.x.59, 3.i.60; Medina, 25.iii.58; Taraba, 27.ii.59; Bisha, 14.

iii.59 ; Taif, 24.iii.59 ; Shakra, 14.x.59 ; Djedda, 27.xi.57, 4.xii.57, 15. xi.58, 6.xii.58, 5.i.59, 4.ii.59, 28.iii.59, 23.iv.59, 6.v.59, 21.ix.59, 6.x.59, 14.xi.59, 1.xii.59, 3.i.60, 9.ii.60.

COLEOPTERA

Cicindelidae

Cicindela melancholica F. : Riyad, 17.ix.57.

Carabidae

C a r a b i n a e . — *Calosoma chlorostictum* Klug : Djedda, 17.iii. 56, 16.iv.56 ; Medina, 26.iii.58 ; Riyad, 3.v.56.

S c a r i t i n a e . — *Scarites eurytus* F. : Djedda, 5.v 56.

A n t h i i n a e . — *Anthia duodecimguttata* Bon. : Gizan, 7.iii.58. — *Anthia sexmaculata* F. : Riyad, on animal manure, 30.iii.57.

H a r p a l i n a e . — *Heteracantha depressa* Brullé : Riyad, 4.v.56.

P t e r o s t i c h i n a e . — *Sphodrus leucophthalmus* L. : Riyad, 4.v.56.

Gyrinidae

Dineutes grandis Klug : Taif, 16.iii.58.

Dytiscidae

Eretes sticticus L. : Djedda, 7.iii.56.

Staphylinidae

Bledius ? niloticus Er. : Djedda, at lamp light, 28.viii.56. — *Quedius* sp. : Djedda, at lamp light, 17.iii.56.

Histeridae

Saprinus chalcites Ill. : Riyad, 18.vi.58.

Melyridae

Melyris klugi Baudi : Gizan, 5.iii.58.

Elateridae

Agrypnus notodonta L. : Djedda, 12.iii.56, 24.iv.56, 29.v.56, 28.viii. 56. — *Cardiophorus* sp. : Gizan, on great millet, 4.iii.58.

Buprestidae

Julodis iris Cast.-Gory : Djedda, apple tree stem, 29.iv.56 ; Riyad, apple tree stem, 20.iii.57. — *Julodis fimbriata* Klug : Djedda, apple tree stem, 29.iv.56. — *Julodis spectabilis* Gory : Yemen, probably imported by M.H. Housny, 10.xii.56. — *Pseudocastalia arabica* Gestro : Djedda, in house, 3.vii.56.

Dermestidae

Anthrenus fasciatus Hbst. : Djedda, in house, 1.iv.56. — *Attagenus gloriosus* Fab. : Djedda, 26.viii.56. — *Dermestes vulpinus* F. : Djedda, in house, 3.vii.56. — *Trogoderma granarium* Everts. : Riyad, on barley, 20.x.58.

Nitidulidae

Carpophilus hemipterus L. : Riyad, on rotten pomegranate fruits, 2.x.57. — *Carpophilus humeralis* F. : Riyad, on rotten pomegranate fruits, 20.x.57. — *Carpophilus* sp. : Riyad, on rotten pomegranate fruits, 20.x.57.

Cucujidae

Oryzaephilus surinamensis L. : Medina, on dry dates, 30.i.59.

Coccinellidae

E p i l a c h n i n a e . — *Epilachna chrysomelina* F. (always on cucurbitaceae) : Riyad, 12.vi.56, 17.ix.57, 30.x.57, 13.v.58, 29.viii.58, 29.ix.58, 4.x.58, 9.xi.58 ; Medina, 27.xi.56 ; Djedda, 1.xii.58 ; Al Kharg, 30.x.59, 5.xi.59 ; Tabouk, 2.ix.58.

C o c c i n e l l i n a e . — *Adonia variegata* Goeze : Gizan, on great millet, 4.iii.58. — *Chilocorus bipustulatus* L. : Riyad, on "nabk" (*Zizyphus* sp.) tree leaves, 28.v.58 ; feeding on *Aphis* sp. on cabbage, 15.vii. 58, 25.i.59 ; feeding on *Aonidiella orientalis* (Coccoidea), 29.xii.59. — *Chilomenes propinqua* Muls. : Gizan, on great millet, 4.iii.58. — *Chilomenes vicina* Muls. : Gizan, on great millet, 4.iii.58 ; Medina, on great millet, 25.iii.58. — *Coccinella 7-punctata* L. : Riyad, on cucurbitaceae, 13.v.58, 6.vii.58. — *Coccinella 11-punctata* L. : Riyad, on cucurbitaceae, 12.vi.56. — *Cydonia vicina subsignata* F. : Gizan, on great millet, 4.iii. 58. — *Scymnus punctillum* W. : Riyad, 20.viii.57.

Bostrychidae

Phonapate frontalis F. : Wadi Khulais, on pomegranate tree stem, 12.iii.58.

Anobiidae

Lasioderma serricorne F. : Riyad, on barley, 20.x.58 ; Medina, on garlic,; 14.iii.56.

Meloidae

Cylindrothorax angusticollis Haag : Djedda, on great millet, 16. iv.56 ; Gizan, on great millet, 4.iii.58. — *Lydoceras fasciata* Mars. : Gizan, on tooth brush trees, 6.iii,58. — *Mylabris elegans* Ol. : Gizan, 5.iii.58. — *Mylabris maculiventris* Klug : Gizan on tooth brush trees, 6.iii.58. — *Mylabris nigriplantis* Klug : Gizan, on tooth brush trees, 4.iii.58. — *Mylabris sp.* : Gizan, on tooth brush trees, 5.iii.58.

Tenebrionidae

E r o d i i n a e . — *Erodius* sp. : Riyad, 16.iii.57.

E p i t r a g i n a e — *Curimosphena villosus* Haag : Djedda, 4.vi. 56, 28.viii.56, 1.ix.56.

Z o p h o s i n a e . — *Zophosis quadricostata* Sol. : Gizan, 5.iii.58. — *Zophosis sulcata* Deyr. : Gizan, 6.iii.58.

T e n t y r i i n a e . — *Mesostena angustata* F. : Riyad, 19.ii.56, 3.ix.58. — *Mesostena puncticollis* Sol. : Djedda, in house, 17.iii.56. — *Tentyrina böhmi* Rtt. : Gizan, 4.iii.58.

A d e s m i i n a e . — *Adesmia bicarinata* Klug : Medina, 13.ii.56. — *Adesmia clathrata* Sol. : Riyad, 3.v.56, 10.xii.56, 20.iii.57, 30.v.57 ; Medina, 26.iii.58 ; Taif, 16.iii.58. — *Adesmia cothurnata* F. : Riyad, 3.v.56. — *Adesmia interrupta* Klug : Gizan, 3.iii.58 ; Taif, 16.iii.58. — *Adesmia (Onymacris) jeanneli* Koch : Gizan, 11.iii.58 ; Taif, 16.iii.58. — *Adesmia* sp. : Taif, 15.iii.58 ; Taraba, 18.iii.58. — *Adesmia* sp. : Gizan, 11.iii.58 ; Taif, 16.iii.58.

S e p i d i i n a e . — *Vieta tuberculata* Sol. : Gizan, under tooth brush tree, 7.iii.58.

P i m e l i i n a e . — *Ocnera sparsispina* Böhm : Djedda, 22.vi.56, 1.vii.56, 8.ix.56 ; Medina, 15.v.56. — *Ocnera* sp. : Riyad, 30.v.57. — *Ocnera* sp. : Riyad, 17.ix.57. — *Pimelia* sp. : Gizan, 7.iii.58 ; Taif, 16. iii.58.

O p a t r i n a e . — *Anemia sardoa* Gené : Gizan, 16.iii.58. — *Gonocephalum rusticum patruele* Er. : Riyad, 13.v.58.

U l o m i n a e . — *Alphitobius diaperinus* Panz.: Djedda, 26.viii.
'56. — *Tribolium castaneum* Hbst. (on wheat and barley): Djedda,
14.iii.56 ; Gizan, 5.iii.58.

Scarabaeidae

C o p r i n a e . — *Catharsius inermis* Cast.: Djedda, 1.iii.56 ; Gi-
zan, 9.iii.58. — *Onthophagus* sp.: Djedda, 8.iii.56. — *Scarabaeus sacer*
L.: Riyad, 3.v.56 ; Gizan, 6.iii.56 ; Taif, 16.iii.58.

A p h o d i i n a e . — *Aphodius granulifrons* Fairm.: Riyad, 9.xii.
56. — *Aphodius* sp.: Djedda, 23.iv.56.

H y b o s o r i n a e . — *Hybosorus illigeri* Reiche: Djedda, 26.
viii.56.

M e l o l o n t h i n a e . — *Schizonycha pygidialis* Arrow: Gizan,
5.iii.58. — *Schizonycha* sp.: Djedda, 1.iv.56.

R u t e l i n a e . — *Adoretus aegrotus* Burm.: Gizan, 7.iii.58. —
Anomala egregia Gaham: Taif, 10.ix.57. — *Anomala* sp.: Gizan, 9.iii.
58. — *Rhinyptia plana* Walker: Gizan, 7.iii.58.

D y n a s t i n a e . — *Oryctes desertorum* Arrow: Medina, on date
palm trees, 13.ii.56. — *Pentodon bispinosus* Kr.: Djedda, at lamp light,
14.iii.56 ; Riyad, 22.v.56, 6.ix.56. — *Phyllognathus silenus* F.: Djedda,
23.iv.56.

C e t o n i n a e . — *Homothyrea inornatipennis* Gahan: Medina,
23.iii.58. — *Stalagmosoma cynanche* G.-P.: Djedda, at lamp light, 23.
iv.56. — *Tropinota squalida* Scop.: Riyad, 26.iii.57.

Cerambycidae

Zoodes liturifer Walk.: Djedda, 19.iv.56.

Chrysomelidae

E u m o l p i n a e . — *Macroma leprieuri* L.: Gizan, on great
millet, 4.iii.58.

G a l e r u c i n a e . — *Rhaphidopalpa (Aulocophora) foveicollis*
Lucas : Wadi Khulais, on winter squash, 24.xi.58 ; Djedda, on water
melon, 17.xii.58 ; Al Harik, on cucurbitaceae, 14.viii.59.

H a l t i c i n a e . — *Podagrica puncticollis* Wse: Gizan, on great
millet, 6.iii.58.

C a s s i d i n a e . — *Aspidomorpha tecta* Boh.: Medina, 25.iii.58.

Bruchidae

Bruchus rufimanus Boh.: Djedda, on broad beans, 12.vi.56; Riyad, on broad beans, 31.xii.58. — *Callosobruchus chinensis* L.: Djedda, on broad beans, 12.vi.56. — *Callosobruchus maculatus* F.: Riyad, on broad beans, 12.vi.56.

Scolytidae

Ips sp.: Abha, under apple tree bark, 24.viii.59.

Curculionidae

T a n y m e c i n a e . — *Dereodus* sp.: Gizan, 5.iii.58.

C l e o n i n a e . — *Coniocleonus planidorsis* Fairm.: Djedda, 7.iii. 56, 17.iii.56, 29.v.56. — *Cosmogaster* sp.: Gizan, 5.iii.58. — *Neocleonus mitis* Gerst.: Gizan, 5.iii.58. — *Pycnodactylus albogilvus* Gyll.: Gizan, 4.iii.58. — *Pycnodactylus tomentosus* Fahrs.: Riyad, 3.ix.57.

C u r c u l i o n i n a e . — *Derelomus* sp. (in the male inflorescence of the palm tree): Taif, 25.viii.57; Taraba, 27.ii.59.

H y l o b i i n a e . — *Hypera variabilis* Hbst. (always caught on alfalfa): Taif, 16.iii.58, 25.x.59; Medina, 5.i.58, 16.xii.58, 11.i.59, 10.ii. 59; Riyad, 12.ii.58, 26.i.59, 11.ii.59, 8.i.60; Taraba, 27.ii.59; Bisha, 14.iii.59; Balgurashi, 18.iii.59; Djedda, 1.iv.59, 22.ix.59; Al Kharg, 20.x.59; Tabouk, 28.vi.59; Hail, 12.vii.59.

C a l a n d r i n a e . — *Calandra granaria* L.: Djedda, on wheat and barley, 18.iii.56. — *Calandra oryzae* L.: Djedda, on great millet, 16.iii.56; Hufouf, on rice, 16.ix.57.

M e c i n i n a e . — *Alcides willcocksi* Pic (from "nabk" tree fruits, *Zizyphus* sp.): Medina, 25.iii.58; Riyad, 3.ix.58.

HYMENOPTERA

Formicidae

Cataglyphis bicolor Fab.: Bisha, on soil, 14.iii.59. — *Camponotus compressus fellah* F.: Hufouf, on date palm trees, 8.ii.60. — *Monomorium pharaonis* L.: Medina, on soil, 12.vii.59.

Mutillidae

Apterogyna savignyi Klug: Medina, 24.iii.58. — *Ephutomma continua aurea* Klug: Medina, 24.iii.58.

· Scoliidae

Campsomeris thoracica eriophora Klug : Riyad, 5.ix.56 ; Taraba, 18.iii.58. — *Dielis collaris* F. : Djedda, 19.iv.56 ; Riyad, 5.ix.56, 10.iii. 57, 2.xi.57. — *Dielis* sp. : Djedda, 19.iv.56. — *Scolia erythrocephala* F. : Medina, 24.iii.58. — *Scolia* sp. : Djedda, 19.iv.56.

Chrysididae

Cephalochrysis ehrenbergi Dahlb. : Gizan, 4.iii.58. — *Stilbum splendidum.* F. : Medina, 2.iii.57.

Eumenidae

Eumenes campaniformis gracilis Sauss. : Taif, 17.iii.58. — *Eumenes maxillosus* F. : Taif, 16.iii.58 ; Gizan, 7.iii.58. — *Eumenes maxillosus dimidiatipennis* Sauss. : Djedda, 7.iii.56, 3.iv.56, 18.v.56 ; Taif, 17. iii.58. — *Eumenes maxillosus fenestralis* Sauss. : Taif, 17.iii.58. — *Eumenes niger* Br. : Djedda, 7.iii.56. — *Eumenes* sp. : Taif. 17.iii.58. — *Odynerus niloticus* Sauss. : Gizan, 3.iii.58. — *Rhynchium cyanopterus* Sauss. : Gizan, 4.iii.58.

Pompilidae

Cryptochilus sp. : Djedda, 19.iv.56. — *Cyphononyx flavicornis* F. : Djedda, 19.iv.56 ; Riyad, 9.xii.56 ; Taraba, 18.iii.58. — *Pompilus* sp. : Djedda, 19.iv.56.

Vespidae

Belonogaster sp. : Taif, 16.iii.58. — *Vespa orientalis* F. : Taif (on spignel flowers), 23.iii.59.

Sphecidae

Ammophila tydei Guill. : Taif, 16.iii.58. — *Sphex hirtus* Kol. : Djedda, 19.iv.56. — *Sphex spendidum* F. : Gizan, 5.iii.58. — *Sphex umbrosus* Christ. : Djedda, 5.iii.56.

Bembecidae

Bembex chlorotica Spin. : Riyad, 3.v.56. — *Bembex fischeri* Spin. : Djedda, 5.iii.56. — *Bembex lusca* Spin. : Djedda, 5.iii.56, 19.iv.56.

Stizidae

Stizus vespoides W. : Djedda, 19.iv.56.

Andrenidae

Andrena sp. : Taif, 16.iii.58.

Megachilidae

Megachila maxillosa Guér. : Gizan, 6.iii.58.

Xylocopidae

Xylocopa aestuans L. (on flowers) : Djedda, 13.iii.56, 29.iv.56 ; 27.vi.56, 3.ix.56 ; Gizan, 6.iii.56 ; Taraba, 18.iii.58 ; Abha, 9.iii.59 ; Khamis Meshait, 11.iii.59 ; Bisha, 14.iii.59 ; Taif, 23.iii.59. — *Xylocopa ? valga* Gerst. (on flowers) : Taraba, 18.iii.58 ; Abha, 12.iii.59 ; Riyad, 17.ix.57.

Anthophoridae

Anthophora wegeneri Pr. : Djedda, 19.iv.56. — *Anthophora* sp. : Riyad, 20.x.57. — *Anthophora* sp. : Medina, 24.iii.58.

Apidae

Apis mellifica L. : Abha, from native bee-hives, 4.iii.59.

DIPTERA

Bombyliidae

Hyperalonia monacha Klug : Djedda, 1.iii.56.

Trypetidae

Ceratitis capitata Wied. : Medina, on orange fruits, 21.x.56 ; Taif, on quince and guava fruits, 6.ix.59 ; Riyad, on mandarine fruits, 20.i. 60. — *Dacus ciliatus* Loew : Djedda, on cucurbitaceae, 28.ii.56, 5.i.59, 28.iii.59 ; Riyad, 21.ix.57, 2.x.57, 15.xi.57, 15.xi.57, 26.viii.58, 30.ix.58, 8.x.58, 9.xi.58, 4.v.59, 19.viii.59, 1.ix.59, 8.x.59 ; Medina, on cucurbitaceae, 2.xi.56, 27.iii.58 ; Al Kharg, on cucurbitaceae, 16.x.59, 27.xi.59 ; Alharik, on cucurbitaceae, 14.viii.59.

Muscidae

Apodacra sp. : Djedda, 26.viii.56 ; Riyad, 21.viii.57. — *Musca cuth-bertsoni* Patten : Riyad, at lamp light, 22.ix.57, 27.ix.58.

Sarcophagidae

Sarcophaga destructor Mall. (*flagellata* Vill.) : Gizan, parasitising insects, 5.iii.58 ; Riyad, parasitising *Dacus ciliatus* Loew, 30.x.58. — *Sarcophaga falculata* P. : Djedda, in houses, 17.iii.56. — *Sarcophaga* sp. : Medina, 25.iii.58.

Tachinidae

Gonia bimaculata Wied. : Taif, 16.iii.58.

Oestridae

Hippobosca camelina L. : Djedda, 6.vi.56.

ABUNDANCE OF THE EARLY STAGES AND ADULTS OF Prodenia litura (F.) IN BERSEEM FIELDS

[Lepidoptera : Noctuidae]

(with 1 Text-Figure and 1 Table)

by EL-SAYED ABDEL-NABY NASR, B.SC., M.SC.,
*Cotton Insects Investigations, Ministry of Agriculture,
Dokki (Giza), Egypt.*

INTRODUCTION

Fields of berseem harbour the cotton leaf worm during the winter season. This crop is known to be the main source of early infestation to cotton plants.

The present work deals with the estimation of population density of the cotton leaf worm in beseem fields in a farm at Giza. It also gives useful information regarding the method of sampling and selection of sites where larvae and pupae are found. Such information is very important from the stand point of forecasting potential outbreaks of this pest on cotton.

MATERIALS AND METHODS

A number of soil samples, varying between 20 and 30, were taken at random from the field and at weekly intervals. The technique of sampling of the soil is the same followed by MOUSSA (1953). Each

sample was taken from an area of one square foot of soil surface and to a depth of 4 inches.

The soil samples were fairly distributed to represent the different sections of the field. Samples were taken from areas spotted along the two axes of the field in such a way that the centre of the field, its margins and the areas in between, were represented. Each sample was taken by using a metal frame 1×1 foot and 4 inches deep which was laid on the surface and pushed down by hands. Plants within the frame were cut close to soil surface and both were kept in a labelled cloth bag. Plants of each sample were examined in the laboratory directly for larvae while the soil was put in a Berlese funnel set on a fruit jar with 70% alcohol to receive the larvae. A record was kept for the number of larvae found in each sample. Results of sampling were expressed as the total number of larvae found in eighty samples in a period of one month.

Records of the air and the soil temperatures were obtained throughout the season. The former was supplied from the Weather Bureau at Giza while the latter was obtained by inserting a weekly thermograph into the soil of the berseem field.

Also an attempt was made to study the local distribution and abundance of the pupae in the fields of berseem. Soil samples taken for this purpose on regular intervals, were of the size, number and manner as previously described.

The population density of the moths was obtained by a light trap set by the Department of Cotton Insects Investigations, in the farm of the College of Agriculture at Giza.

RESULTS AND DISCUSSION

Larvae

BISHARA (1934) reported that very few larvae were found in berseem fields from January to April. Examination of soil samples taken during the period between December and June showed that the population of the larvae was very low (Fig. 1, B). The total number of larvae obtained per eighty samples ranged between nil to 25. The mean air and soil temperature recorded in December were 11 and 14°C., respectively, and continued to rise steadily until they reached 27 and 26°C. in June (Fig. 1, A).

Pupae

A very low population density of pupae of the cotton leaf worm was observed between December and May. BISHARA (1934) stated that only a few pupae were found in January. During the course of this work, the maximum number of pupae found in eighty soil samples did not exceed 4 in the mentioned period (Fig. 1, C). In May, a sudden small rise in the population of pupae was noticed, slowly increasing in June. This increase in population coincided very well with the rise of both air and soil temperatures (Fig. 1, A).
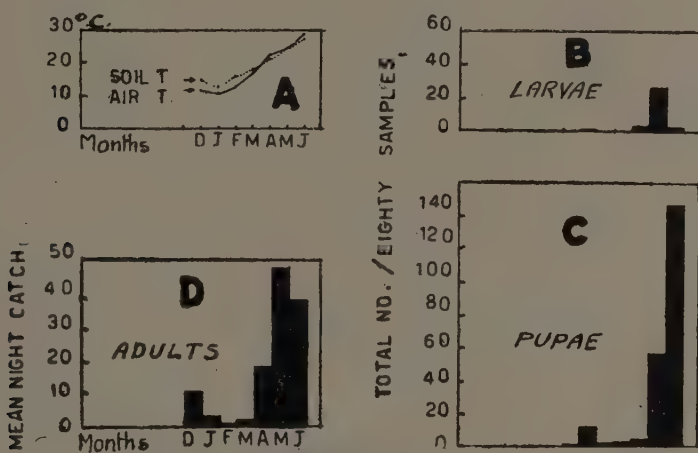
FIG. 1: Abundance of the cotton leaf worm in berseem fields.

The distribution of pupae in the fields of berseem varied according to soil elevation. Observations made showed that more pupae were found in elevated areas than in plane ones of the same field. The number of pupae per square foot of unit area was 2 in plane areas and 5 in elevated ones (Table I). Numbers obtained in both areas were not due to a chance, but were highly significant as shown by the analysis of variance.

Adults

Results obtained from the light trap showed that the mean nightly catch of moths for the months during the period between

TABLE I

Distribution of pupae in elevated and levelled areas at Giza in 1958.

Site of sampling	Number of soil samples	Number of pupae per sq. foot		
		Max.	Min.	Mean ± S.E.
Levelled areas	69	12	0	2.0 ± 0.09
Elevated areas	24	14	0	5.0 ± 0.29

December and June were 10, 3, 1, 2, 17, 45 and 36, respectively. In general, the population of moths was very low during winter months and high in May and June (Fig. 1, D). These figures coincide with the records of temperature obtained for May and June (Fig. 1, A).

SUMMARY

Populations of larvae and pupae are very low in berseem fields from December to May. These results coincide with the records obtained for moths catch by a light trap during the same period. Also, the distribution of pupae varied with soil elevation in the field.

ACKNOWLEDGMENT

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EXTERNAL MORPHOLOGY OF THE ADULT

Sinoxylon sudanicum Lesne

[*Coleoptera : Bostrychidae*]

(with 29 Text-Figures)

by ALY BADAWY, PH.D.,
Faculty of Agriculture, Ain Shams University,

and FAWZIA NAGUIB, B.SC.,
Plant Protection Department, Ministry of Agriculture.

The wood borer, *Sinoxylon sudanicum* Lesne (Fig. 1), is a common pest in the Sudan, India and Indo-China, where it causes serious loss and great damage to non-coniferous trees. As most other mem-

Fig. 1: *Sinoxylon sudanicum* Lesne, adult, × 10.

bers of this family, adults of this species tunnel into drying and dead trees, freshly cut logs, old try wood and timber used in buildings. Green shoots are probably liable to attack, and as a result, the leaders of seedlings and young saplings may be killed. In severe infestations, the larvae and adults occur in such numbers that the timber is wholly destroyed and the wood is reduced to fine powder. The presence of round entrance holes and tunnels following the annual rings of growth are characteristic features of infestation.

ANDRES (1931) recorded *Sinoxylon ceratoniae* (probably *S. sudanicum* Lesne) in the Nile Delta attacking *Poinciana regia* grawn as a shade and ornamental trees. Records of its occurrence in old trees of Mango, Acacia, Casuarina, Poinciana, Ficus, Delbergia were also given (records of the Ministry of Agriculture, Egypt). Specimens of this species had been sent to the British Museum (Natural History), and to the Division of Insect Identification, U.S. Dept. Agric., in 1955 and 1960 and were identified as *Sinoxylon sudanicum* (Lesne, 1895).

A study of the available literature shows that detailed studies concerning its morphology, is still lacking. In the present work, an account on the external morphology of the adult is given. Drawings were made with the help of a camera lucida .

Head and its appendages

HEAD CAPSULE (Figs. 2 and 3) : Hypognathous, globular in shape, being deflexed and protected by prothorax. Vertex smooth, heavily sclerotized, posterior part of head capsule membranous, epicranial suture represented by the coronal suture, frontal sutures absent. Clypeus broad and transverse extending on each side to tooth at base of labrum, clypeal suture distinct. Eyes small, strongly projecting on both sides of head. Antennae widely separated, inserted immediately between eyes and bases of mandibles. Occipital foramen large and oval. Two gular sutures present forming a small gula, pregula thus extending to base of submentum. Postgena located lateral to gula and pregula, its anterior margin presents two articular surfaces : the paracoilae (receiving the maxillae) and postcoilae (for the articulation of mandibles).

ANTENNAE (Fig. 4) : 10-segmented, scape elongate, three times as long as pedicel, first five segments of flagellum very short and compact, last three segments strongly transverse forming a loose club, clothed with fine hairs and distinct yellow pubescent spots.

MANDIBLES (Fig. 5) : Heavily sclerotized, nearly triangular, provided with a large abductor muscle and a small abductor one. Inner surface differentiated into an incisor lobe of two teeth, a lacinia mandibula
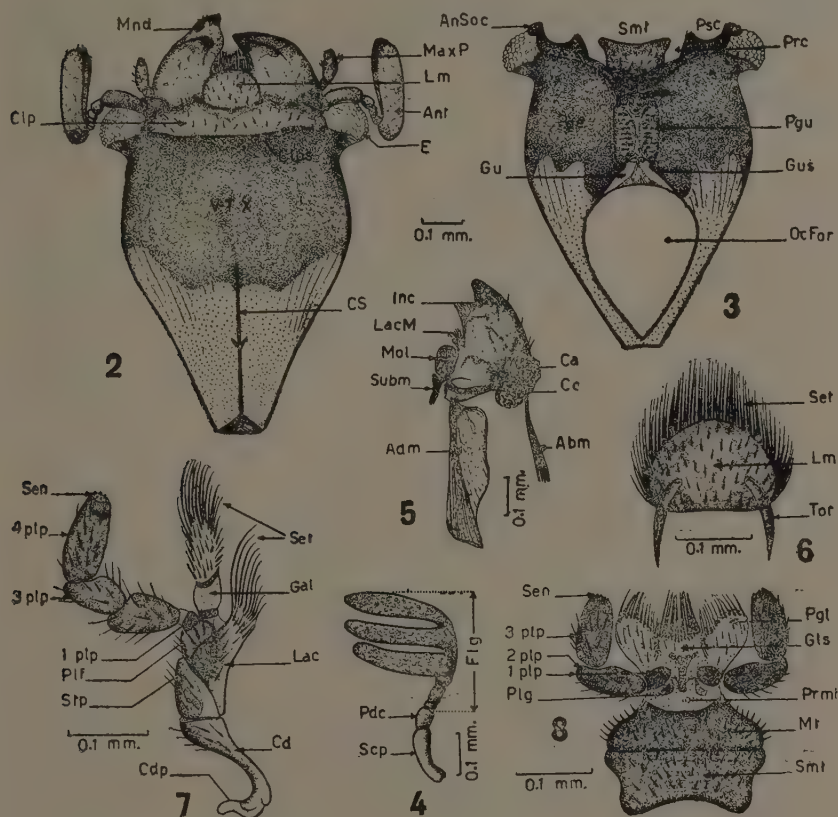
FIGS. 2 and 3: Head capsule, dorsal and ventral view (mouth parts removed), respectively (*AnSoc*, antennal socket; *Ant*, antenna; *Clp*, clypeus; *Clps*, clypeal suture; *CS*, coronal suture; *E*, eye; *Gu*, gula; *Gus*, gular suture; *Lm*, labrum; *MaxP*, maxillary palp; *Mnd*, mandible; *OcFor*, occipital foramen; *Pge*, postgena; *Prc*, paracoila; *Psc*, postcoila; *Smt*, submentum; *VTX*, vertex; *Pgu*, pregula). — FIG. 4: Antenna (*Flg*, flagellum; *Pdc*, pedicel; *Scp*, scape). — FIG. 5: Mandible (*Abm*, abductor muscle; *Adm*, adductor muscle; *Ca*, gynglymus; *Co*, condyle; *Inc*, incisor lobe; *LacM*, lacinia mandibula; *Mdl*, molar lobe; *Subm*, submola). — FIG. 6: Labrum (*Lm*, labrum, *Set*, setae; *Tor*, torma). — FIG. 7: Maxilla (*Cd*, cardo; *Cdp*, cardial process; *Gal*, galea; *Lac*, lacinia; *Plf*, palpifer; *Sen*, sensory organs; *Set*, setae; *Stp*, stipes; *1-4 plp*, segments of maxillary palp). — FIG. 8: Labium (*Gls*, glossa; *Mt*. mentum; *Pgl*. paraglossa; *Plg*, palpiger; *Prmt*, prementum; *Sen*, sensory organs; *Smt*, submentum; *1-3 plp*, segments of labial palp).

·bearing a tuft of hairs and a large molar lobe with a fine submola at its base. A small rounded condyle and the gynglymus serve for ventral and dorsal articulation of mandible.

LABRUM (Fig. 6): Approximately rectangular with both sides · rounded. Free margins thickly fringed with setae, being much longer at the anterior margin. Two tormae on both sides serve for articulation of labrum to head capsule.

MAXILLAE (Fig. 7): Cardo elongate, provided with a small cardial process embedded in the paracoila. Stipes of two sclerites, one triangular and heavily sclerotized, the latter cylindrical and act as a palpifer. Galea of two parts, the distal being fringed with long hairs. Lacinia nearly triangular, with apex bearing a number of long hairs directed inwards. Maxillary palp 4-segmented, basal segment very small, second and third segments subequal and shorter than the fourth, the latter being provided with papilla-like sense organs at tip.

LABIUM (Fig. 8): Submentum and mentum large and heavily sclerotized, prementum membranous. Glossae fuse to form a single lobe bearing a tuft of long hairs. Paraglossae appear as two lateral lobes on both sides of glossae, free margins fringed with hairs. Labial palp 3-segmented set up on a palpiger, basal segment verq small, 2nd. and 3re. segments approvimately equal with the latter being provided with papilla-lige sense organs at membranous tip.

Thorax and its appendages

PROTHORAX (Figs. 9 and 10): Hood like, being almost as long as broad, all sclerites completely fused without apparent sutures. Pronotum extend ventrolaterally on both sides, anterolateral surfaces with blunt teeth directed backwards, posterolateral surfaces tuberculate. Anterior foramen (receiving the head) wide and rounded, occupying the anterior part of ventral surface thus reducing the prosternum to a very narrow area representing the basisternum, a small part projecting backwards represent the sternellum. Propleuron of a large episternum and a relatively smaller and narrower epimeron, pleural suture absent. The two epimera wide apart, joined together by means of a ligament separating the coxal cavities of the fore legs and the posterior foramen to which the mesothorax is attached.

MESOTHORAX (Figs. 11, 12 and 13): *Mesonotum:* Prescutum narrow, separated from scutum by the prescutal suture. Anterior part of scutum divided with a median suture into two equal parts, each bearing a prealar anteriorly and a postnotal wing process posteriorly.

Scutellum occupies the posterior part of mesonotum. Two lateral more or less membranous extensions represent the postscutellum
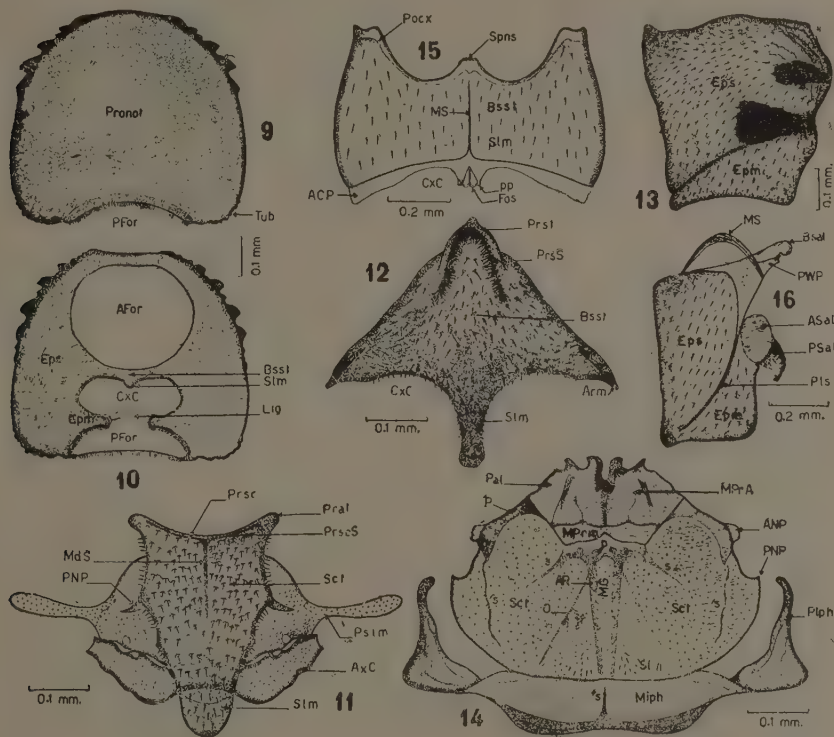
FIGS. 9 and 10: Prothorax, dorsal and ventral view, respectively (*AFor*, anterior foramen; *Bsst*, basisternum; *CxC*, coxal cavity; *Epm*, epimeron; *Eps*, episternum; *Lig*, ligament; *PFor*, posterior foramen; *Pronot*, pronotum; *Slm*, sternellum; *T*, tooth; *Tub*, tubercles). — FIG. 11: Mesonotum, dorsal view (*AxC*, axillary cord; *MdS*, median suture; *PNP*, posterior notal wing process; *Pral*, prealar; *Prsc*, prescutum; *PrscS*, prescutal suture; *Pslm*, postscutellum; *Sct*, scutum; *Slm*, scutellum). — FIG. 12: Mesosternum, ventral view (*Arm*, arm; *Bsst*, basisternum; *CxC*, coxal cavity; *PrsS*, presternal suture; *Prst*, presternum; *Slm*, sternellum). — FIG. 13: Mesopleuron, external (*Epm*, epimeron; *Eps*, episternum; *Pls*, pleural suture). — FIG. 14: Metanotum, dorsal view (*ANP*, anterior notal wing process; *AR*, alar ridge; *MG*, median groove; *Miph*, mediophragmite; *MPrA*, median prescutal area; *MPrM*, median prescutal membrane; *n,O*, apodemes; *P,'P*, sclerotized plates; *Pal*, prealar; *Plph*, pleurophragmite; *PNP*, posterior notal wing process; *Sct*, scutum; *s,'s,"s*, sutures). — FIG. 15: Metasternum, ventral view (*ACP*, antecoxal piece; *Bsst*, basisternum; *CxC*, coxal cavity; *Fos*, fossa; *MS*, median suture; *Pocx*, postcoxale; *PP*, posterior process; *Slm*, sternellum; *Spns*, spinasternum). — FIG. 16: Metapleuron, external (*ASal*, anterior subalar; *Bsal*, basalar; *Epm*, epimeron; *Eps*, episternum; *MS*, median suture; *Pls*, pleural suture; *Psal*, posterior subalar; *PWP*, posterior wing process).

behind which a heavily sclerotized axillary cord is present. *Mesoster-num :* Presternum narrow, separated from basisternum by a reversed U-shaped presternal suture fringed with dense setae. Basisternum large occupying the major part of mesosternum and possessing two lateral arms. A median arm extending backwards represent the sternellum. The two lateral arms of basisternum together with the median arm of sternellum form the coxal cavities of the middle legs. *Mesopleuron :* Nearly quadrate, divided by an oblique pleural suture into an anterior and large spisternum and a posterior and relatively smaller epimeron.

METATHORAX (Figs. 14, 15 and 16) : *Metanotum :* More or less membranous with a large number of sutures and apodemes present. Prescutum composed of a median prescutal area, prealar, and a median prescutal membrane. Anterior notal wing process arises at the base of a narrow and more sclerotized area located just behind the prealar. Scutum of two lateral areas separated by the scutellum. Each area is divided by two intrascutal sutures into an anterior, posterior and outer plates, the posterior notal wing process arises at the outer margin of the latter. Scutellum occupies the median region between the two lateral areas of scutum. It consists of a median groove limited laterally by two alar ridges which serve to hold the elytra in place when at rest (CRAMPTON, 1918). At the anterior end if the ridges, four apodemes arise from a fairly sclerotized area, two directed laterally, the others extend backwards. On both sides of the posterior part of median groove, two lateral scutellar lobes are present. Postscutellum is represented by a traverse plate attached to the posterior margin of metanotum and is divided by a median suture into two lateral plates, each of the latter consists of a mediophragmite extending laterally and pleurophragmite directed downwards and terminating with a pointed process. *Metasternum :* Wide and sclerotized, basisternum and sternellum fused being divided by a longitudinal suture arising from base of metasternum into two lateral areas. Anterior margin of metasternum presents the median spinasternum of mesothorax and the postcoxale on both sides. At its posterior margin, a narrow area exists representing the antecoxal piece. The latter bears two fossae serving for the articulation of metendosternite, on both sides two small processes serve for the articulation of hind coxae. *Metapleuron :* Approximately oblong, composed of an episternum and epimeron separated by the pleural suture. The pleural wing process and the basalar arise from the anterior lateral part of metapleuron, a number of muscle stalks are attached to their base. Two small and weekly sclerotized

plates in the membranous area joining the metapleuron and metanotum represent the subalar.
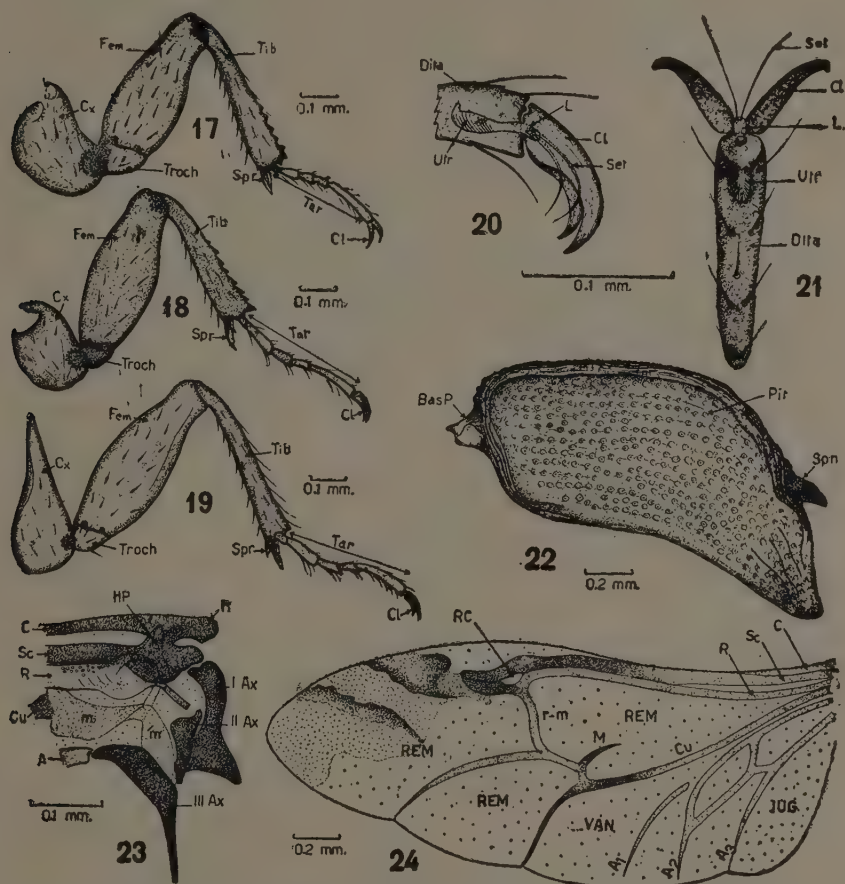
FIGS. 17, 18 and 19: Fore, middle and hind legs, respectively. — FIGS. 20 and 21: Distal tarsal segment, side and ventral view, respectively (*Cl*, claw; *Cx*, coxa; *Dita*, distal tarsal segment; *Fem*, femur; *L*, median lobe; *Set*, setae; *Spr*, spur; *Tar*, tarsus; *Tib*, tibia; *Troch*, trochanter; *Utr*, unguitractor). — *Spr*, spur; *Tar*, tarsus; *Tib*, tibia; *Troch*, trochanter; *Utr*, unguitractor. — FIGS. 22, 23 and 24: Fore wing, axillary sclerites of hind wing and hind wing, respectively (*A*, *A₁*, *A₂*, *A₃*, anal veins; *BasP*, basal plate; *C*, costa; *Cu*, cubitus; *h*, head of costa; *HP*, humeral plate; *Jug*, jugum; *m,'m*, median plates; *Pit*, pits; *R*, radius; *RC*, radial cell; *REM*, remigium; *r–m*, radio-media; *Sc*, subcosta; *Spn*, spine; *VAN*, vannus; *I, II, III Ax*, axillary sclerites).

LEGS (Figs. 17, 18, 19, 20 and 21): Coxae not similar in all legs, being contiguous in fore legs, almost spherical in the middle and cone-

shaped in hind legs. Trochanter small, articulating free with coxa, but fix to base of femur by means of two condyles, almost similar in size and shape in all legs. Femur long, being thick in the middle, but narrows gradually towards both ends. Tibia slender and elongate, anterior and middle pairs dentate on anterior margins. Distal end somewhat broader, bearing a number of strong teeth and toothed spurs ; a single spur on fore tibia, and a pair of unequal spurs on the middle and hind tibia. Tarsal formula 5-5-5, basal segment much reduced and almost hidden by the tibia, terminal segment approximately as long as the preceding three segments together. Distal tarsal segment bears a pair of long and curved claws and a ventral median plate or unguitractor extending forwards between claws to form a median lobe with two long setae.

ELYTRA (Fig. 22) : Heavily sclerotized, sides slightly expanded posteriorly, a very strong and conspicuous spine present at the lateral posterior margin. Proximal part ending with a basal process to which the axillary sclerites are attached. Wing venation indistinguishable, small rounded pits arranged in rows could be detected in mounted specimens, a fine hair arises at base of each pit.

HIND WING AND AXILLARY SCLERITES (Figs. 23 and 24) : Membranous, composed of the remigium, vannus and jugum, the latter being devoid of veins. Three axillary sclerites and two median plates join the hind wing to metathorax. Wing venation of a reduced and modified Cantharid type, characterized by the following : 1. Presence of radial cell ; 2. "M" loop reduced to a mere hook ; 3. "R" and "M" joined by the r-m cross vein ; 4. "M" and "Cu" coalesce distally to form a definite loop, at the point of junction a single vein is continued to wing margin and regarded as "M" (IMMS, 1957).

Abdomen and genitalia

ABDOMEN (Figs. 25, 26 and 27) : Five abdominal sterna visible in both sexes, the first being morphologically the 3rd., first two membranous, much reduced, divided by a median process of 3rd. sternum into two lateral parts. Eighth and ninth segments present in males, the latter being absent in females. Ninth sternite in males consist of two chitinized struts joined anteriorly to form a reversed "U", both struts are connected by a membrane. Two slightly chitinized sclerites continuous ventrally with the two struts of sternite represent the tergite.

FEMALE GENITALIA (Figs. 27 and 28) : Of the elongate type (TANNER, 1927), consisting of the styli, coxites and valvifers. Styli small and

palpiform, born at the end of the coxite which shows signs of secondary division. Genital opening or vulva opens between the two styli. Valvifers reduced to long supporting bacculi ensheathed in a thin membrane extending forwards inside the abdomen forming a loop. POTTER (1935) considers this membrane as representing the 9th. segment.
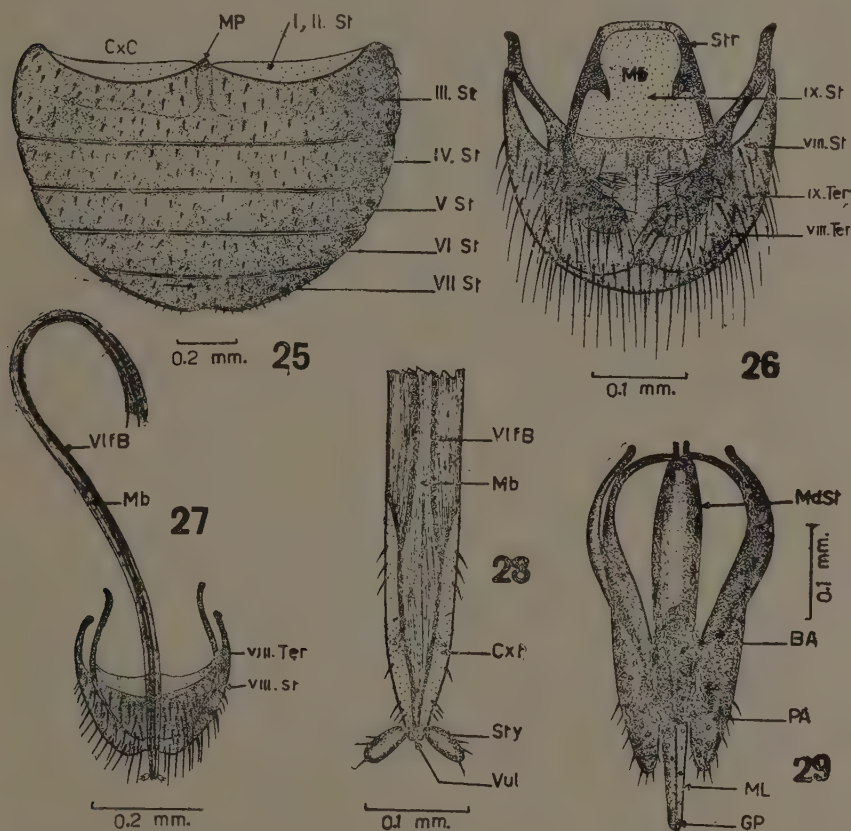
FIG. 25: Apparent abdominal sternites (*CxC*, coxal cavity; *MP*, median process; *St*, sternites). — FIG. 26: Eighth and ninth abdominal segments in males (*Mb*, membrane; *St*. sternites; *Str*, strut; *Ter*, tergites). — FIG. 27: Eighth abdominal segment in females, with ovipositor (*Mb*, membrane; *St*, sternite; *Ter*, tergum; *VlfB*, valvifer bacculus). — FIG. 28: Terminal part of ovipositor, magnified (*Cxt*, coxite; *Mb*, membrane; *Sty*, style; *VlfB*, valvifer bacculus; *Vul*, vulva). — FIG. 29: Male genitalia (*BA*, basal plate; *GP*, genital opening; *MdSt*, median strut; *ML*, median lobe (penis); *PA*, paramere).

MALE GENITALIA (Fig. 29): Median lobe or penis tubular bearing two projecting chitinous rods or median struts anteriorly. Genital

opening ventral, opens at tip of penis. Median lobe enclosed in the tegment, the latter consists of two parameres and a basal plate. Parameres are two large lobes on both sides of penis extending anteriorly to form a pair of filiform apophyses. Basal plate represented by a median sclerite moulded over the ventral surface of the fusion of parameres and extend laterally as two chitinized rods. The two pairs of prolongations of parameres and basal plate approach to their homologies and embrace the penis.

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THE IDENTITY OF THE Trogoderma
OF THE SUDAN

[*Coleoptera : Dermestidae*]

(with 2 Text-Figures and 3 Tables)

by A. KHALIFA,

Faculty of Agriculture, Khartoum University, Sudan,

and A. BADAWY,

Faculty of Agriculture, Ain Shams University, Cairo.

The width of the antennal segments especially in the basal part of the flagellum has proved to be of taxonomic importance in *Trogoderma*. The common species found in Upper Egypt was described by PRIESNER (1951) under the name of *afrum ;* but HOWE and BURGES (1956) have not taken into consideration the special form of the antenna given by PRIESNER and concluded that *afrum* Priesner is a synonym of *granarium* Everts. A detailed study by the writers and a closer examination by Dr. R.W. HOWE, however, proved that the shape of the antennae in the two forms were quite different and PRIESNER'S description remained to be valid. The two forms interbreed freely with each other and fertile adults could be obtained indefinitely. The shape of the antennae in the crosses deviated from that of *granarium* and *afrum* and the behaviour in F1 and F2 of the hybrids proved that the difference between the two forms is genetically determined. It is, therefore, proposed that *granarium* Everts is to be splitted into two subspecies : *granarium granarium* Everts and *granarium afrum* Priesner.

The geographical distribution of these two subspecies calls, therefore, for a further study. The population in Upper Egypt may be either genetically isolated or extends farther southwards in the Sudan, a point which is the subject of the present paper.

For the sake of the most correct method of ascertaining the iden-
tity of the common *Trogoderma* of the Sudan, the antennae after
boiling the insects in caustic potash, washed in water and dehydrated,
were severed and mounted in Canada balsam. Measurements were
taken of the widths of nine segments of only one antenna in 30 indi-
viduals taken at random. The scape and pedicel were excluded on
account of being identical in the two sub-species referred to above.
The mean widths of the antennal segments of the Sudanese *Trogo-
derma* are shown in Table I which contains similar informations per-
taining to *granarium afrum*, *granarium granarium* and to the adults
of the first generation obtained by the cross: male *afrum* × female
granarium. They are also shown graphically in Figures 1 and 2. The
result of analysing these data statistically is shown in Table II from
which it can be observed that there is a persistant significant differ-
ence between the width of every antennal segment in *afrum* and the
Sudanese *Trogoderma*. When *granarium granarium* and the Sudanese
Trogoderma were compaired it was found that in both sexes the first
five segments showed closely similar means and the differences
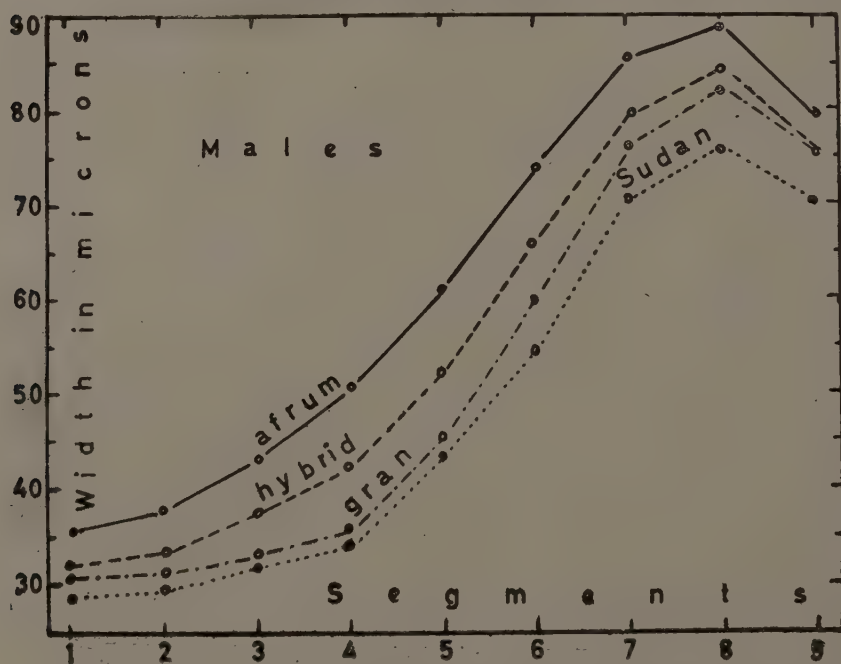
FIG. 1: Mean width of antennal segments in males of Sudanese *Trogoder-
ma*, *T. granarium afrum*, *T. granarium granarium* and the hybrid in microns.

(except in the case of the second segment in males) were insignificant. But it was found that the remaining segments in the Sudanese form were consistently narrower than the corresponding segments of *gra-narium granarium* and that the differences were significant. Such variations in the absolute measurements of the distal segments would not be as important as the general shape of the antenna which is determined by the width of the first four segments. In *granarium grana-*
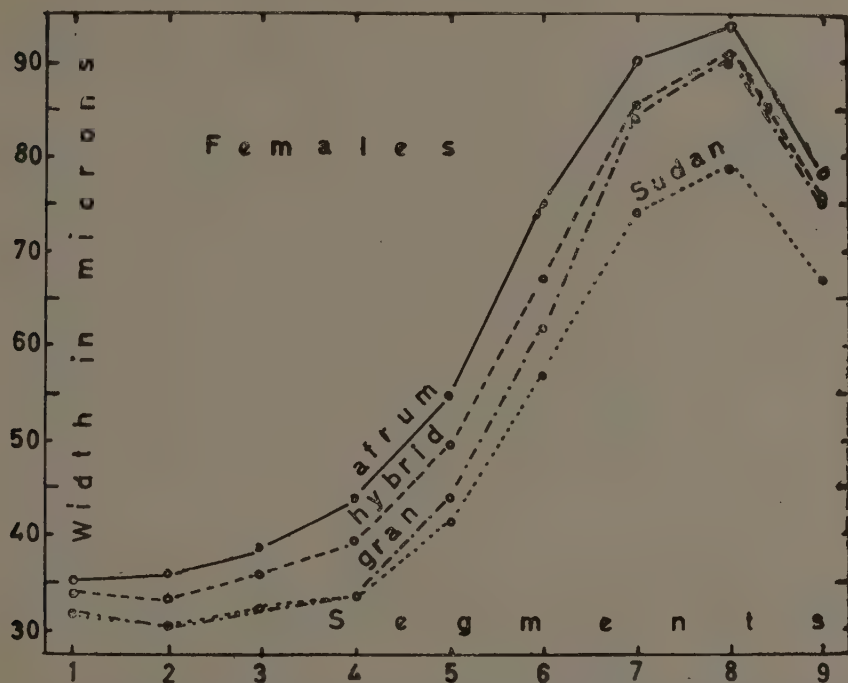
FIG. 2: Mean width of antennal segments in females of Sudanese *Trogoderma*, *T. granarium afrum*, *T. granarium granarium* and the hybrid in microns.

rium the basal segments of the antenna are much more slender and narrower, the distal segments forming the club being therefore more differentiated from the rest than in *granarium afrum*. In the latter the basal segments increase successively in width and thus the club is less clearly separated. In the Sudanese form, however, the club is well differentiated though its segments are a little narrower. The slope showing the gradual increase in the width of the antennal segments is more or less parallel to that of *granarium* especially in the males (Fig. 1).

The close similarity between *granarium granarium* and the Suda-nese *Trogoderma* can also be shown when the increase in width from the first to the fourth segment is computed. This is shown in Table III, from which it can be observed that the mean increase in *granarium* and the Sudanese form is nearly similar but very much different from *afrum* and the hybrid.

TABLE I.

Mean width of antennal segments of Sudanese Trogoderma, T. granarium afrum, · T. granarium granarium *and the hybrid (male* afrum × *female* granarium) *in microns.*

Segment	FEMALES				MALES			
	Sudanese Trogoderma	afrum	grana-rium	Hybrid	Sudanese Trogoderma	afrum	grana-rium	Hybrid
1	28.93	35.54	30.86	31.94	31.14	35.11	31.78	33.90
2	29.34	37.47	31.34	33.09	31.00	35.67	30.05	33.23
3	31.97	42.74	33.23	37.13	32.38	38.74	31.99	35.97
4	33.77	50.23	35.65	42.10	33.77	44.03	33.68	38.98
5	43.87	60.70	45.70	52.15	41.93	54.46	43.63	49.30
6	54.80	73.55	60.43	66.02	57.30	75.25	62.05	67.05
7	70.81	85.35	76.43	79.36	74.71	90.14	84.60	85.68
8	76.37	88.90	82.18	64.36	79.27	93.88	80.81	91.37
9	70.70	78.88	75.11	75.46	67.39	78.04	74.98	75.06

TABLE II.

Result of comparing statistically the widths of the antennal segments of the Sudanese Trogoderma· *with those of* granarium granarium *and* granarium afrum.

Segment	MALES				FEMALES			
	granarium × Sudanese		afrum × Sudanese		granarium × Sudanese		afrum × Sudanese	
	F obtained	Result	F obtained	Result	F obtained	Result	F obtained	Result
1	1.93	−	6.61	+	0.64	−	3.97	+
2	2.00	+	8.13	+	0.95	−	4.67	+
3	1,26	−	10.77	+	1.39	−	6.36	+
4	1.88	−	16.56	+	0.09	−	10.26	+
5	1.83	−	16.83	+	1.70	−	15.53	+
6	5.63	+	18.75	+	4.75	+	17.95	+
7	5.60	+	14.52	+	9.89	+	15.43	+
8	5.81	+	12.53	+	11.54	+	14.61	+

+ = Difference is significant at P level of 1%.
− = Difference is insignificant at the same level.

It can be concluded, therefore, that the Sudanese *Trogoderma* is very much closer to *granarium granarium* than to *granarium afrum* or the hybrid between them and that *afrum* is geographically isolated and remains so distinct in the shape of its antenna.

TABLE III.

Mean increase from the first to the fourth antennal segment in the Sudanese Trogoderma, granarium afrum, granarium granarium *and the hybrid.*

Species	MALES mean increase in microns	FEMALES mean increase in microns	Number of insects used
Sudanese *Trogoderma*	4.87	2.63	30
T. granarium afrum	14.78	8.99	30
T. granarium granarium	4.75	1.87	30
Hybrid	10.13	5.05	30

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FOOD PREFERENCE

OF Trogoderma granarium granarium Everts,
Trogoderma granarium afrum Priesner
AND Trogoderma irroratum Reitter
AND THE EFFECT OF DIET ON THEIR BIOLOGY

[*Coleoptera : Dermestidae*]

(with 4 Text-Figures and 4 Tables)

by A. KHALIFA,
Faculty of Agriculture, Khartoum University, Sudan,

and A. BADAWY,
Faculty of Agriculture, Ain Shams University, Cairo.

In the present work a biological study of food preference of *Trogoderma granarium granarium* Everts, *granarium afrum* Priesner and *irroratum* Reitter was carried out, and the effect of different food material on the duration of developmental stages, weight of pupae and number of eggs laid was also studied. The first instar larvae were used in three sets of experiments. In the first experiment sieved flour of wheat, maize, barley, rice and rice bran were offered as food. In the second dried ground fish, meat, lepidopterous and hymenopterous insects and raw wool were used. Out of these ten types of food the four types which were found to be the most attractive were chosen for use in the third experiment.

Howe and Burges (1952) used a simple apparatus to test the food preference for egg laying of Ptinid beetles. The same apparatus with slight modifications was used. The apparatus (Fig. 1) consists of a

glass dish (a) 4.5 cm. deep and 15 cm. diameter, the bottom of which was covered by a thick cardboard disc (b). Five holes (c), symmetrically placed and 4.5 cm. diameter, were made in the cardboard disc 0.5 cm. from the edge. The disc was placed in the dish so that the holes fitted over 5 filter paper, 5.5 cm. diameter. Equal volumes of foods were placed at random in the holes. Not less than 100 first instar larvae were introduced in the centre of the dish. Soon after
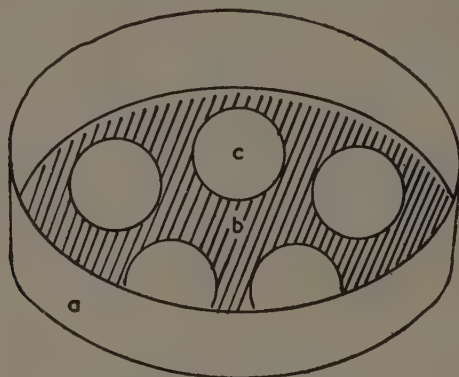
Fig. 1: Apparatus used in food preference experiments (a, glass dish; b, cardboard disc; c, five holes).

the apparatus was covered by a blackened bell jar and the larvae moved in complete darkness. Ten replicates were made for each experiment and counts were made after a period of 24 hours.

When using diets of plant origin it was noticed that larvae of *granarium afrum* and *granarium granarium* showed a marked tendency to crawl towards barley flour; nearly 40% of the total number of larvae of each species were attracted to this diet. *Irroratum* larvae, however, were more attracted to maize.

Maize flour was more attractive to *granarium afrum* and *granarium granarium* larvae than rice flour, the difference between the two diets is significant. But again maize was found to be equally attractive as wheat and rice bran; the difference between these diets was insignifiant. With the exception of the difference between the percentages of *irroratum* larvae attracted to rice bran on one side and both barley and wheat on the other side, all other diets differ significantly (Fig. 2).

When experiments were carried out using diets of animal origin it was found that *granarium afrum* and *irroratum* larvae were more attracted to dried fish, while dried lepidopterous insects was more

attractive to *granarium granarium* larvae. Statistical analysis of data shows that with the exception of the difference between fish and lepidopterous insects in case of *granarium afrum* and *granarium granarium,* and that between meat and wool in case of *granarium granarium* and *irroratum* the differences between all remaining diets were statistically significant. In almost all replicates, meat and raw wool received the least number of larvae (Fig. 3).
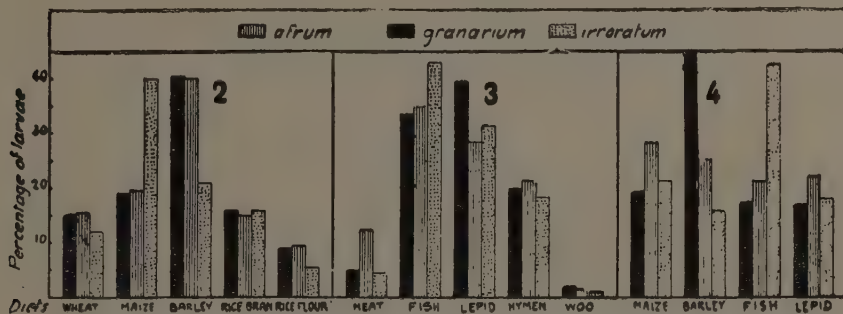
FIG. 2: Percentages of larvae attracted to different diets of plant origin. — FIG. 3: Percentages of larvae attracted to different diets of animal origin. — FIG. 4: Percentages of larvae attracted to different diets of both plant and animal origin.

Of the ten different types of food offered in the preceeding experiments barley and maize flour, dried fish and lepidopterous insects proved to be the most attractive. Experiments carried out on these four types of food showed the following results :

(a) In case of *granarium afrum* all the diets attracted approximately equal numbers of larvae : 29.1, 25.8, 21.9 and 23.1% of the total number of larvae were attracted to maize, barley, fish and lepidopterous insects, respectively (Fig. 4). Only the difference between maize and fish is statistically significant.

(b) Barley flour was more attractive to *granarium granarium* larvae, 46.0% of the total number of larvae used was attracted to this diet. The difference between barley on one hand and all other diets on the other is highly significant, but no significant difference occurs between the remaining three diets.

(c) *Irroratum* larvae showed a tendency to crawl towards fish which received 43.6% of the total number of larvae. The difference between fish and all other diets is highly significant but between all other diets is insignificant.

On the basis of the preceeding data we can conclude that the three insects under consideration showed definite preferences for certain

diets, the determining factor is very likely to be an olfactory res-
ponse. Each of the four types of foods which proved to be the most
attractive to larvae has a remarkable characteristic odour. Similar
experiments carried out by HOWE and BURGES (1952) on Ptinids and
CHAPMAN (1918) on larvae and adults of *Tribolium confusum* agree in
that these insects react not necessarily to foods of high nutritive
values.

Effect of diet on the biology of the three species

Different cultures of the three species of *Trogoderma* were set
up on different food materials and incubated at constant conditions of
35°C. and 70% relative humidity. The food stuffs employed were
whole wheat flour, whole maize flour, rice bran together with ground
dried fish, ground dried hymenopterous and lepidopterous insects. In
addition a parallel experiment was performed in which 5% by weight
of dried brewer's yeast was added to the dried fish which was found
to give the slowest rate of growth. In egg-laying experiments all the
food stuffs used with the exception of those of dried insects were
passed through a sieve of about 60 mesh/inch. The number of moults
on different diets was counted in *granarium afrum* and *irroratum*.
The diapause individuals were not considered. Eggs laid by fertilized
females were left till hatching and were then counted as larvae.

The larval period
(Table I)

Among diets of plant origin the most rapid development occurred
on barley in case of *granarium afrum* and *irroratum* and on wheat in
case of *granarium granarium*. The shortest average length obtained
were 15.0, 14.4 and 32.4 days for males and 18.6, 17.6 and 35.9 days
for females of *granarium afrum, granarium granarium* and *irroratum*,
respectively. On maize and rice bran larval development of *grana-
rium afrum* and *irroratum* took a comparatively longer time. In *gra-
narium granarium* the larval period was the same on barley and rice :
15.7 and 18.9 days were obtained for male and female larvae on both
diets. On maize larval development of *granarium granarium* was
relatively slow : 16.7 and 19.4 days for males and females, respectively.

Dried fish which is known to contain the smallest amount of vita-
min B gave the slowest rate of growth. This occurred in the three
insects. The mean durations of the larval period were 32.3, 24.7 and

TABLE I.

Effect of diet on the duration of the larval stage in Trogoderma granarium afrum, granarium granarium and irroratum.

Diet		afrum			granarium			irroratum		
		Mean ± S.E.	Range	No. used	Mean ± S.E.	Range	No. used	Mean ± S.E.	Range	No. used
Wheat	males	16.3 ± 0.39	14–19	16	14.4 ± 0.11	14–15	22	33.9 ± 1.92	24–61	23
	females	19.1 ± 0.23	18–20	21	17.6 ± 0.21	15–19	23	40.3 ± 1.44	24–60	28
Maize	males	17.0 ± 0.33	15–20	23	16.7 ± 0.39	15–21	15	48.1 ± 4.42	25–80	17
	females	20.3 ± 0.37	19–26	24	19.4 ± 0.25	17–22	28	59.5 ± 3.32	39–83	19
Barley	males	15.0 ± 0.11	14–16	25	15.7 ± 0.20	14–19	23	32.4 ± 1.54	21–48	20
	females	18.6 ± 0.92	18–20	21	18.9 ± 0.19	17–21	20	35.9 ± 1.36	27–50	23
Rice bran	males	19.5 ± 0.43	16–24	23	15.7 ± 0.21	14–19	27	52.4 ± 3.53	31–80	17
	females	23.9 ± 0.49	20–29	24	18.9 ± 0.17	18–20	16	63.6 ± 4.65	39–92	15
Fish	males	32.3 ± 1.10	25–41	16	24.7 ± 0.14	24–26	21	108.8 ± 11.24	73–131	5
	females	37.6 ± 0.95	32–50	21	29.1 ± 0.27	26–31	24	120.9 ± 2.56	97–134	15
Hymenopterous insects	males	19.8 ± 0.56	16–24	19	17.3 ± 0.39	16–21	20	52.9 ± 4.60	27.82	19
	females	23.5 ± 0.47	20–28	21	21.0 ± 0.15	20–22	19	54.2 ± 4.35	28–87	19
Lepidopterous insects	males	20.2 ± 0.66	13–24	16	17.3 ± 0.36	16–21	21	49.8 ± 2.27	27–65	22
	females	22.6 ± 0.35	20–27	24	20.8 ± 0.14	20–22	19	53.6 ± 2.58	30–68	17
Fish + yeast	males	20.9 ± 0.07	17–23	25	16.4 ± 0.38	15–22	23	85.7 ± 3.43	62–96	10
	females	24.9 ± 0.54	20–28	16	20.1 ± 0.23	19–22	20	92.8 ± 4.36	78–117	17

108.8 days for males and 37.6, 29.1 and 120.9 days for females of *granarium afrum, granarium granarium* and *irroratum,* respectively. In case of *irroratum,* however, a large number of larvae failed to pupate and were still in the larval stage after a period of six months.

Larval development on dried hymenopterous and lepidopterous insects was almost equal and faster than on dried fish. The average durations on hymenopterous insects were 19.8, 17.3 and 52.9 for males and 23.5, 21.0 and 54.2 days for females of *granarium afrum, granarium granarium* and *irroratum,* respectively ; the corresponding length of time on lepidopterous insects were 20.2, 17.3 and 49.8 for males and 22.6, 20.8 and 53.6 days for females, respectively.

Judging by the duration of larval stage on these different diets it can be concluded that diets of plant origin (cereals) have a higher nutritional value than those of animal origin.

TABLE II.

Effect of diet on the number of moults of Trogoderma granarium afrum.

Diet		Number of larval moults							No. used
		2	3	4	5	6	7	8	
Wheat	males	1	15						16
	females		3	18					21
Maize	males		19	4					23
	females		1	21					24
Barley	males	3	22						25
	females		7	14					21
Rice bran	males		8	15					23
	females			16	8				24
Fish	males			2	6	8	1		17
	females				4	11	5	1	21
Hymenopterous insects	males		7	12					19
	females			15	5	1			21
Lepidopterous insects	males		2	14					16
	females			21	2	1			24
Fish + yeast	males		1	24					25
	females			4	12				16

Number of moults

(Table II)

The number of moults was recorded in case of *granarium afrum* and *irroratum.* On wheat, maize and barley most male larvae of *gra-*

narium afrum had three moults while those of the females had four. On rice, hymenopterous and lepidopterous insects most larvae of both sexes of *granarium afrum* moulted four times. Six moults, however, were observed on dried fish. In case of *irroratum* results show a considerable variation, but fish gave the largest number of moults (10-15 for males and 12-18 for females). Barley on the other hand gave the least number (5-8 for males and 7-9 for females). There is a slight variation in the length of the pupal and pre-emergence period on different foods, but statistical analysis of data shows that there is no significant difference attributed to food.

Weight of pupae

(Table III)

Pupae were weighed on the day of pupation. The weight of pupa seems to be much affected by diet. The weight of female pupae is consistently heavier than that of the males. Comparison between *granarium afrum* and *granarium granarium* shows that with all diets the weight of *granarium granarium* pupae of both sexes is always heavier that that of *granarium afrum* although the larval period of the latter is longer in most cases (Table I). Pupae of *irroratum* are much heavier than both. In case of *granarium afrum* the lightest weight of male pupae occurred on maize (0.81 mgm) and on fish in case of females (2.24 mgm); the heaviest occurred on fish + yeast (1.09 mgm for males and 2.87 mgm for females). In *granarium granarium* wheat and barley gave the heaviest weight in females 3.53 mgm), while fish gave the lowest (2.76 mgm). The male pupae of this species showed the least weight on maize (1.01 mgm), the heaviest on lepidopterous insects (1.17 mgm). In *irroratum*, however, lepidopterous insects gave the highest weights in both sexes (3.11 and 7.25 mgm for males and remales, respectively), the lowest occurred on maize for females (5.01 mgm) and on dried fish for males (2.02 mgm).

The importance of addition of yeast to food is clearly shown in the appreciable shortening of the larval period which is accompanied by a decrease in the number of moults (Tables I and II). But the mean duration of the larval period on fish + yeast is ,however, still longer than on cereal flour. Besides, the addition of yeast to fish produced a general increase in pupal weight (Table III).

TABLE III.

Effect of diet on weight of pupae of Trogoderma granarium afrum, granarium granarium and irroratum. (Weight in milligrams)

Diet		afrum			granarium			irroratum		
		Mean ± S.E.	Range	No. used	Mean ± S.E.	Range	No. used	Mean ± S.E.	Range	No. used
Wheat	males	0.82 ± 0.002	0.7-1.0	16	1.09 ± 0.02	0.9-1.3	16	2.50 ± 0.04	2.1-3.0	29
	females	2.78 ± 0.07	2.2-3.5	21	3.53 ± 0.08	2.4-4.0	23	5.93 ± 0.11	5.4-6.7	11
Maize	males	0.81 ± 0.03	0.7-1.2	23	1.01 ± 0.04	0.8-1.3	15	2.17 ± 0.05	1.9-2.7	17
	females	2.59 ± 0.05	2.1-3.0	24	3.10 ± 0.07	2.4-3.9	28	5.01 ± 0.14	3.9-6.0	19
Barley	males	0.89 ± 0.01	0.7-1.0	25	1.06 ± 0.02	0.9-1.3	23	2.24 ± 0.04	1.8-2.5	19
	females	2.85 ± 0.06	2.4-3.6	21	3.53 ± 0.05	3.2-4.1	20	5.67 ± 0.16	4.1-7.1	23
Rice bran	males	0.87 ± 0.04	0.6-1.2	23	1.11 ± 0.02	1.0-1.5	27	2.33 ± 0.04	2.1-2.6	17
	females	2.39 ± 0.08	1.9-3.4	24	3.51 ± 0.02	2.9-4.0	16	5.78 ± 0.21	4.4-7.6	15
Fish	males	0.91 ± 0.04	0.7-1.2	16	1.04 ± 0.03	0.9-1.4	21	2.02 ± 0.32	1.3-3.2	5
	females	2.24 ± 0.06	1.7-2.9	21	2.76 ± 0.03	2.2-3.4	24	5.56 ± 0.22	3.7-7.0	15
Hymenopterous insects	males	0.98 ± 0.02	0.7-1.2	19	1.05 ± 0.04	0.9-1.4	20	2.80 ± 0.07	2.2-3.3	19
	females	2.39 ± 0.07	2.0-3.2	21	2.87 ± 0.04	2.4-3.1	19	6.06 ± 0.26	3.8-7.6	19
Lepidopterous insects	males	1.01 ± 0.11	0.8-1.2	16	1.17 ± 0.04	0.9-1.8	21	3.11 ± 0.08	2.5-4.0	22
	females	2.36 ± 0.07	1.7-3.1	24	3.36 ± 0.07	2.8-4.0	19	7.25 ± 0.25	5.8-9.8	17
Fish + yeast	males	1.09 ± 0.03	0.9-1.5	25	1.09 ± 0.03	0.8-1.4	23	2.75 ± 0.08	2.2-3.3	10
	females	2.87 ± 0.13	2.2-3.5	16	2.94 ± 0.06	2.5-3.7	20	5.62 ± 0.24	3.6-6.9	17

TABLE IV.

Number of eggs laid by Trogoderma granarium afrum, granarium granarium and irroratum on different food stuffs.

Diet	granarium			irroratum			afrum		
	Mean ± S.E.	Range	No. used	Mean ± S.E.	Range	No. used	Mean ± S.E.	Range	No. used
Wheat	77.3 ± 3.84	36-106	20	83.1 ± 6.08	51-127	14	47.9 ± 3.45	22-67	16
Maize	70.4 ± 3.30	41-49	19	76.4 ± 7.51	14-136	21	53.4 ± 2.37	33-72	19
Barley	74.1 ± 3.32	49-101	18	87.5 ± 7.02	34-118	17	50.6 ± 2.53	22-67	18
Rice bran	69.7 ± 2.47	52-85	14	81.5 ± 6.34	14-132	17	47.0 ± 2.66	22-63	17
Fish	57.0 ± 2.53	34-80	18	81.5 ± 8.94	34-171	15	44.4 ± 3.05	23-61	15
Hymenopterous	68.4 ± 2.83	52-87	14	95.9 ± 7.42	22-138	20	45.2 ± 4.23	7-72	16
Lepidopterous	7.7 ± 2.87	1-15	4	21.7 ± 10.17	8-52	4	9.6 ± 2.25	2-28	13
Fish + yeast	70.3 ± 3.23	51-97	15	81.8 ± 4.78	53-125	16	43.5 ± 3.34	21-61	15

Number of eggs laid

(Table IV)

Virgin females bred on different food stuffs were isolated each in a separate tube, provided with a newly emerging male and supplied with the same diet as an oviposition medium. The insects were incubated at 35°C. and 70% relative humidity for about two weeks after which time the number of larvae was counted, and this gave an appropriate estimation of the number of eggs as the percentage of mortality was negligible.

From the data recorded in Table IV the following results can be obtained :

(1) On all diets used *irroratum* gave the highest average number of eggs. *Granarium granarium* showed a higher degree of fecundity than *agranarium afrum ;* the difference between the three insects is statistically significant.

(2) With the exception of eggs laid on dried lepidopterous insects the number of eggs laid on the remaining diets were not very much different. Females of both *granarium afrum* and *granarium granarium* fed on cereal flour laid a slightly higher number of eggs than those fed on diets of animal origin. In case of *irroratum* the highest number was laid by females fed on dried hymenopterous insects, the least by those fed on maize flour. Statistical analysis of data showed that diet had no significant effect on the number of eggs laid.

(3) On dried lepidopterous insects some females of the three species did not lay any eggs, the rest laid the least number as compared with other diets. Out of 20 females of *agrarium afrum* 13 laid an average number of 9.6 eggs ; in *granarium granarium* only 4 out of 20 laid an average of 7.7 eggs and 4 adults out of 14 of *irroratum* laid an average number of 21.7 eggs.

SUMMARY

When given a choice of different diets the first instar larvae of *Trogoderma granarium afrum, granarium granarium* and *irroratum* showed a definite preference for certain diets which had no relation to their nutritive value. The limiting factor is very likely to be an olfactory response.

The most rapid larval development occurred on barley in case of *granarium afrum* and *irroratum* and on wheat in case of *granarium granarium*. Dried fish gave the slowest rate of growth.

Larvae of *granarium afrum* moulted 3-4 times on cereals, those of *irroratum* showed considerable variation. Dried fish increased the number of moults to 6 in *granarium afrum* and 10-18 in *irroratum*.

The pupal and pre-emergence periods seemed to be unaffected by diet, but the weight of pupa differed greatly on different diets.

The addition of yeast to fish was accompanied by an abrupt shortening of the larval period, a decrease in the number of moults and increase in weight of pupae.

The number of eggs laid showed slight variations on different diets.

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THE FLIGHT ACTIVITY
OF NIGHT-FLYING DIPTERA IN RELATION
TO THE WEATHER CONDITIONS IN EGYPT

(with 2 Text-Figures and 6 Tables)

by S. EL-ZIADY and M.F.H. OSMAN,

Department of Entomology, Faculty of Science, Cairo University.

INTRODUCTION

Insect activity and abundance were shown to depend largely upon the prevailing and preceding weather conditions. This relation was studied quantitatively in various parts of the world particularly in England, France and U.S. America. Most of the quantitative estimates have been carried out in England, particularly at the Rothamsted Experimental Station which lies in the cool northern temperate zone.

In temperate and subtropical zones however in which Egypt lies, such useful research has been overlooked for a considerably long time. The following is a statistical analysis of the relation between the weather factors and insect activity and abundance at night and hence insect population, in Egypt.

This country is characterised by four well-defined seasons : a dry warm summer, a mild wet winter and intermediate moderate spring and autumn. No big fluctuations in temperature or any of the other factors occur and the weather during the day is more or less stable in contrast with the very varied conditions prevailing in other countries.

METHODS

Suction traps of the type devised by JOHNSON and EASTOP in 1947 (JOHNSON and EASTOP, 1951) were used in this study. They sample insects at random without depending on any particular tactic responses of the insects compared with the light, colour or smell traps.

FIG. 1: The two suction traps.

Thus these traps enable density estimates of the aerial population of insects to be made at any time of the day or the night with great accuracy.

Two suction traps were used in the present investigation : one was mounted on a wooden stand with its mouth at 5 ft. above ground level and the other was mounted on top of electric pole with its mouth

at 30 ft. high (Fig. 1). Both traps were situated side by side in the farm of the Entomological Department, Faculty of Science, Cairo University, about 60 meters to the south of the main building. The area around the traps was planted with cotton, clover, wheat and some vegetables and the conditions were more or less similar during the two trapping years.

The traps worked continuously for two years from September 1955 to August 1957 except for some breakdowns in the electric current or unavoidable delays in getting replacement motors. Each of the two trapping years covered four seasons : Autumn (Sept.-Nov.) ; Winter (Dec.-Feb.) ; Spring (March-May) and Summer (June-Aug.). Trapping was automatically regulated by an electric switch to begin half an hour after sunset and stop at half an hour before sunrise.

Statistical methods used in the analysis

In the following work the regression equation was used since the catch depends on : (attivity due to temperature × activity due to wind × ..., etc.) × population, or in other words the log. catch = (log. activity due to temperature + log. activity due to wind + ..., etc.) + log. population (WILLIAMS, 1940). Multiple regression of the catch on the different weather factors was calculated, and the method adopted was that of the inversion matrix described by WOOLF (1951), for the three main factors, minimum night temperature, previous day maximum temperature and wind. Other independent variates were added or omitted from the regression as described by the same author. The analysis of variance, the significance of each factor and the percentage of explained variance were also calculated.

The logs. instead of the actual numbers were used in the analysis to eliminate as far as possible the swamping effect caused by few large catches (WILLIAMS, 1937). "1" was added to the number before converting it to its log. to get over the difficulty of log. "0" catch. Also the difference between successive nights both for the catches and the weather factors were considered in the analysis to eliminate as possible the effect of rapid population changes and to emphasize the activity effect (WILLIAMS, 1940).

METEOROLOGICAL RECORDS

The present investigation was carried out at Giza Province, which lies at a latitude 30° North. Temperature, relative humidity and

barometric pressure were continuously recorded throughout the two
trapping years by thermohygrographs and barographs, all calibrated
and adjusted to sea level, and kept close to the traps in the field in
a screen 4 feet above ground level. Wind speed was measured by
3-cup anemometers placed at the two trapping levels. The mean wind
speed during the night was used in the analysis.

Normal climate at Giza

Table I shows the means of the main weather factors at Giza
for the last 30 years. Summer has the highest maximum, the highest
minimum and the highest mean temperatures. Winter, on the other
hand, has the lowest means. Barometric pressure is highest in winter
and lowest in summer. Spring and autumn possess intermediate
temperatures and pressure. Rainfall occurs in winter. Autumn and
spring have little rainfall, while there is hardly any rainfall in sum-
mer. In Egypt, the winter is considered as the wet season, the sum-
mer as the dry one, and it is actually unusual to have any rain in this
latter season. The mean daily sunshine is high in summer, relatively
low in winter, with autumn and spring between the two. This is
partly due to differences in the length of the day. This is long in
summer and short in winter.

In Egypt the maximum day temperature occurs at 2-3 p.m. (Cairo
local time : two hours in advance of G.M.T.), while the minimum night
temperature occurs at dawn.

Weather in the two trapping years

Table I shows the deviations of the mean seasonal values of the
weather factors of the two trapping years from the average of 30 years.
In the two years the minimum temperature was above normal. The
maximum temperature was above the average in all seasons except
the winter of the second year. The mean temperature was above
normal, with exception of the spring of the first year as well as all
seasons of the second year. Pressure and sunshine were below normal
in both years. Negative departures in pressure were well marked in
the spring and summer of the second year.

Rainfall was very much above normal in the winter, particularly
in the second trapping year.

TABLE I

Departures of the chief weather factors in the two trapping years from the average of 30 years

Seasons	Min. Temp. °C.			Max. Temp. °C.			Mean Temp. °C.			Sunshine per day (hours)			Pressure mm.			Rainfall mm./month		
	A	1	2	A	1	2	A	1	2	A	1	2	A	1	2	A	1	2
Autumn	15.2	+1.0	+2.1	29.4	+1.2	+1.6	21.5	+0.7	—0.2	9.4	—	0	761.2	—0.1	—0.4	2.3	—0.8	—2.3
Winter	6.5	+2.4	+0.6	20.7	+2.1	—1.0	12.4	+1.0	—0.5	7.5	—0.5	—0.7	763.5	—1.7	—	3.7	+2.8	+9.4
Spring	11.4	+2.2	+3.5	28.4	+0.8	+1.3	19.4	—0.8	—0.2	10.0	—0.3	—0.5	760.5	0	—3.8	2.3	—2.3	+0.7
Summer	19.2	+3.0	+3.1	35.1	+2.3	+1.1	26.7	+0.4	—0.1	12.0	—0.2	—0.4	757.1	—0.4	—4.3	0.3	—0.3	—0.3

A = Average of 30 years. — 1 = Departures in the first year (1955-56). —

2 = Departures in the second year (1956-57).

Inter-relation of the climatic factors

Seasonal correlations between the various physical factors show that the maximum day temperature was positively correlated with the minimum and the mean night temperatures but negatively correlated with the relative humidity and pressure. Minimum and mean night temperatures both showed a positive correlation with wind and a negative correlation with pressure. The mean temperature was also positively correlated with the minimum night temperature but negatively correlated with the relative humidity. The pressure and the relative humidity were also positively correlated. It is therefore concluded that a high maximum day temperature was associated with a high minimum and a high mean night temperature ; also an increase in either of these three temperatures was accompanied by a decrease in the relative humidity and pressure. Windy nights seem to be warmer than calm nights.

ABUNDANCE OF DIPTERA IN THE NIGHT-CATCH
IN THE TWO TRAPPING YEARS

Diptera was the dominant order in the night catch at both levels. Table II shows the mean monthly log. catch of all insects and Diptera.
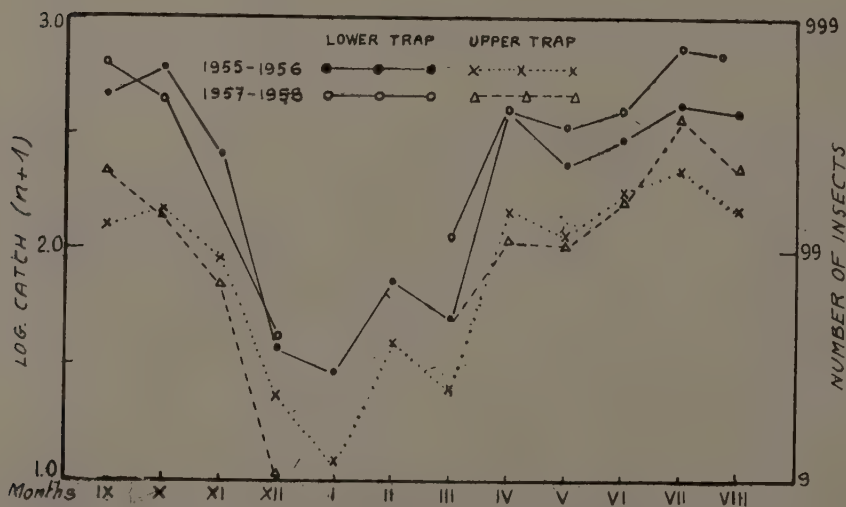
FIG. 2: Abundance of Diptera in the night catch.

TABLE II

Mean monthly log. catch of all insects and Diptera at night.

Traps	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.
Lower Trap												
All insects												
1955-56	2.86	2.92	2.47	1.74	1.52	1.94	1.76	2.62	2.43	2.60	2.77	2.78
1956-57	2.97	2.74	2.45	1.68	—	—	2.12	2.64	2.61	2.77	2.97	3.08
Diptera												
1955-56	2.67	2.80	2.41	1.58	1.46	1.89	1.70	2.58	2.38	2.49	2.64	2.60
1956-57	2.81	2.65	2.40	1.62	—	—	2.05	2.60	2.53	2.60	2.89	2.87
Upper Trap												
All insects												
1955-56	2.18	2.27	1.98	1.37	1.12	1.63	1.45	2.17	2.07	2.78	2.37	2.21
1956-57	2.45	2.22	1.89	1.08	—	—	1.73	2.12	2.04	2.28	2.59	2.44
Diptera												
1955-56	2.10	2.18	1.96	1.36	1.08	1.60	1.40	2.16	2.06	2.25	2.35	2.17
1956-57	2.34	2.16	1.86	1.01	—	—	1.71	2.05	2.01	2.23	2.57	2.35

There was a small difference between the log. catch of all insects and that of Diptera in the same month. For this reason this order will be considered only in the analysis.

Diptera was of regular occurrence in all months in the two traps. It was more abundant near the ground than at 30 ft. The picture of abundance was almost similar in the two years at both levels (Fig. 2).

In the first year, maximum abundance occurred in October for the lower trap and in July for the upper one, whereas July of the second year showed the maximum log. catch at both levels. Minimum abundance, on the other hand, in the two traps occurred in January of the first year. No data are available for that month in the second year, and December of this year showed the least abundance.

It is noteworthy that, at ground level, the population level in the second year was higher than in the first year except in October when a marked increase in the first year existed. November, also, showed a very slight increase in the first year. At 30 ft., on the contrary, the population level was lower in the second year except in September, March, July and August, when the first year had a lower population level than the second year.

PRELIMINARY INVESTIGATION OF THE EFFECT
OF THE DIFFERENT WEATHER FACTORS

For this purpose, the three nights with the highest catch and the three nights with the lowest catch were chosen from each month of the two years for both traps. The deviations of the log. catch on these nights from normal for the month were calculated. Similar nights from the same month of the two years were then grouped together and the mean value for the six nights was obtained. Similar values were then obtained for the different weather factors prevailing on these nights.

The results of such analysis showed that nights of high catches were those with a high maximum temperature of the previous day, high minimum and high mean night temperatures, low wind velocity, less relative humidity and lower barometric pressure. This effect was the same at both trapping levels.

TABLE III

Mean weather conditions during the trapping hours in the different seasons of the two years.

Season	Year	Temperature (°C.)				Mean wind vel. miles/hour		Mean R.H. percentage	Mean pressure in mm.
		Daily range	Max. day	Min. night	Mean night	at 5 ft.	at 30 ft		
Autumn	1955	30.6	16.2	20.2	14.4	1.3	1.7	80.3	761.3
”	1956	31.3	17.3	21.1	14.4	1.8	1.6	82.4	760.9
Winter	1956	22.8	8.9	12.4	13.9	1.2	1.6	84.3	761.6
”	1957	20.9	8.6	11.8	12.3	1.3	1.1	97.2	763.9
Spring	1956	29.2	13.6	18.0	15.6	3.2	2.7	75.9	760.5
”	1957	29.7	14.9	19.2	14.8	2.5	2.1	80.2	756.4
Summer	1956	37.4	22.2	26.4	15.2	2.5	2.3	80.6	757.2
”	1957	36.2	22.3	26.3	14.9	2.7	2.7	74.9	752.4
All Months	1	30.0	15.2	19.3	14.8	2.1	2.1	80.3	760.2
”	2	29.6	15.8	19.6	13.8	2.1	2.1	83.7	758.4
Two years		29.8	15.5	19.5	14.3	2.1	2.1	82.0	759.3

TABLE IV

Seasonal partial regression of Diptera at night on the different weather factors (Lower trap).

Season	Year	d.f.	TEMPERATURE				Wind	R.H.	Pressure
			Max. day	Min. night	Mean night	Daily range			
Autumn	1955	72	$+.026 \pm .015$	$+.005 \pm .016$	$+.059 \pm .020^{**}$	$+.021 \pm .004^{**}$	$-.221 \pm .036^{**}$	$-.003 \pm .004$	$+.014 \pm .016$
"	1956	78	$+.005 \pm .013$	$+.013 \pm .015$	$+.069 \pm .021^{**}$	$-.008 \pm .003^{*}$	$-.189 \pm .025^{**}$	$+.005 \pm .003$	$+.006 \pm .019$
Winter	1956	90	$+.054 \pm .014^{**}$	$+.038 \pm .019^{*}$	$+.104 \pm .019^{**}$	$+.015 \pm .002^{**}$	$-.138 \pm .034^{**}$	$+.004 \pm .004$	$-.047 \pm .017^{*}$
"	1957	30	$+.080 \pm .031^{*}$	$+.113 \pm .045^{*}$	$+.167 \pm .049^{**}$	$-.033 \pm .009^{**}$	$-.105 \pm .067$	$+.018 \pm .018$	$-.038 \pm .054$
Spring	1956	91	$+.023 \pm .010^{*}$	$+.113 \pm .018^{**}$	$+.115 \pm .021^{**}$	$-.090 \pm .002^{**}$	$-.226 \pm .022^{**}$	$+.008 \pm .004^{*}$	$-.024 \pm .023$
"	1957	90	$+.030 \pm .011^{**}$	$+.044 \pm .017^{*}$	$+.108 \pm .019^{**}$	$-.014 \pm .002^{**}$	$-.164 \pm .027^{**}$	$+.0004 \pm .003$	$+.001 \pm .017$
Summer	1956	85	$+.045 \pm .015^{**}$	$-.015 \pm .019$	$+.014 \pm .024$	$+.060 \pm .004^{**}$	$-.059 \pm .031$	$-.007 \pm .004$	$+.003 \pm .031$
"	1957	76	$+.009 \pm .020$	$-.040 \pm .022$	$+.053 \pm .027$	$+.049 \pm .006^{**}$	$-.150 \pm .028^{**}$	$-.011 \pm .004^{**}$	$+.038 \pm .021$
All Months	1	341	$+.040 \pm .007^{**}$	$+.046 \pm .010^{**}$	$+.074 \pm .010^{**}$	$-.005 \pm .001^{**}$	$-.165 \pm .015^{**}$	$+.0007 \pm .002$	$-.024 \pm .011^{*}$
"	2	277	$+.035 \pm .008^{**}$	$+.035 \pm .011^{**}$	$+.100 \pm .013^{**}$	$+.00003 \pm .001$	$-.151 \pm .017^{**}$	$+.0008 \pm .002$	$+.003 \pm .011$
Two years		619	$+.038 \pm .005^{**}$	$+.041 \pm .007^{**}$	$+.068 \pm .008^{**}$	$-.003 \pm .0004^{**}$	$-.158 \pm .011^{**}$	$-.0003 \pm .001$	$-.013 \pm .008$

Winter 1957 is represented by December 1956 only. — Significant coefficients are only those marked with asteriks: ** = P ranges between .001 or less —.01 level; * = P ranges between .01 and —.05 level.

TABLE V

Seasonal partial regression of Diptera at night on the different weather factors (Upper trap).

Season	Year	d.f.	TEMPERATURE				Wind	Pressure
			Max. day	Min. night	Mean night	Daily range		
Autumn	1955	56	+.002 ±.016	−.002 ±.020	−.003 ±.026	+.004 ±.005	−.132 ±.037**	+.002 ±.019
„	1956	70	+.024 ±.014	−.013 ±.016	−.011 ±.023	+.037 ±.003**	−.190 ±.032**	−.031 ±.023
Winter	1956	88	+.081 ±.013**	−.0003 ±.018	+.048 ±.019*	+.081 ±.003**	−.145 ±.026**	−.014 ±.019
„	1957	30	+.033 ±.025	+.076 ±.037*	+.102 ±.042*	−.043 ±.007**	−.247 ±.074**	−.096 ±.045*
Spring	1956	87	+.024 ±.012	+.092 ±.023**	+.090 ±.024**	−.068 ±.003**	−.168 ±.036**	−.069 ±.026*
„	1957	84	+.043 ±.012**	+.038 ±.020	+.110 ±.023**	+.005 ±.002*	−.129 ±.032**	−.015 ±.020
Summer	1956	79	+.034 ±.012**	+.012 ±.016	+.034 ±.020	+.023 ±.003**	−.056 ±.027*	+.005 ±.026
„	1957	77	−.006 ±.027	−.039 ±.030	+.076 ±.036*	+.033 ±.008**	−.130 ±.055**	+.024 ±.030
All Months	1	313	+.046 ±.007**	+.027 ±.010*	+.044 ±.011**	+.020 ±.0008**	−.129 ±.016**	−.023 ±.012*
„	2	264	+.041 ±.008**	+.022 ±.012	+.079 ±.014**	+.019 ±.0009**	−.146 ±.020**	−.026 ±.012*
Two years		578	+.044 ±.005**	+.025 ±.008**	+.057 ±.009**	+.019 ±.0004**	−.136 ±.013**	−.025 ±.008**

Autumn 1955 is represented by October and November. — Winter 1957 is represented by December 1956 only. — Significant coefficients are only those marked with asterisks: ** = P ranges between .001 or less and .01 level; * = P. ranges between .01 —.05 level.

QUANTITATIVE ANALYSIS OF THE EFFECT OF THE DIFFERENT WEATHER CONDITIONS AT NIGHT ON THE ACTIVITY OF DIPTERA

Maximum temperature of the previous day

Table III shows the mean weather factors during the night in the different seasons of the two years, while Tables IV and V show the regression coefficients of Diptera on these factors.

Regression coefficients on the maximum temperature of the previous day were positive for the two traps except in the summer of 1957 for the upper trap when the regression coefficient was negative. This latter value, however, was not significant. These positive regressions indicate that the higher the maximum temperature of the previous day, the greater the activity of Diptera on the following night.

All regression coefficients for the lower trap were significant in the spring and the winter of the two years and the summer of the first year. In the autumn of both years and the summer of the second year, the regression coefficients were non-significant. For the upper trap, the effect was significant only in the winter and summer of the first trapping year together with the spring of the second year. The "All Months" and the "Two Years" regressions were all positive and highly significant for both traps.

Maximum regression coefficient occurred in the winter of the second year for the lower trap and the winter of the first year for the upper trap where one degree rise in the previous day maximum temperature caused 0.080 ± 0.031 rise in the log. catch of Diptera in the lower and 0.081 ± 0.013 in the upper traps, i.e. doubling the catch of both traps would have been effected by a rise of $3.8°C$. in the previous day maximum temperature (other weather factors being normal).

Minimum effect, on the other hand, was observed in the autumn of 1956 for the lower trap and the autumn of 1955 for the upper trap when one degree rise in maximum temperature caused a decrease in the log. catch of 0.005 ± 0.013 in the lower trap and 0.002 ± 0.016 in the upper trap.

Minimum night temperature

The regressions for the lower trap (Table IV) were positive in all seasons except in the summer of the two years. That is to say, an increase in the minimum night temperature caused an increase in the

night catch of Diptera near the ground in winter, spring and autumn ; whereas in summer an increase in the minimum night temperature suppressed the activity of the night flying Diptera at the same level.

For the upper trap (Table V), the relation between Diptera and the minimum night temperature seems to be non-consistent ; the regressions were sometimes positive and sometimes negative.

The values of the regression coefficients were significant only in the winter and the spring of the two years for the lower trap, and in the spring of 1956 and the winter of 1957 for the upper trap. Maximum effect of the minimum temperature occurred in the winter of 1957 and spring of 1956 which had similar values for the lower trap and one degree rise in the minimum night temperature would have increased the log. catch of Diptera by 0.113 ± 0.045 and 0.113 ± 0.018. In the upper trap, maximum effect occurred in the spring of 1956 when one degree rise in the minimum temperature would have raised the log. catch by 0.092 ± 0.023.

Minimum effect occurred in the autumn of 1955 for the lower trap (regression coefficient $+0.005 \pm 0.016$) and in the winter of 1956 for the upper trap (regression coefficient -0.0003 ± 0.018).

The "All Months" and the "Two Years" regressions were positive for the two traps. They were highly significant at or less than 0.001 level of probability for the lower trap and the "All Months" regression of the second year was non-significant for the upper trap.

Tables IV and V show higher regressions for the lower trap than for the upper one. This may lead to the suggestion that nocturnal Diptera might respond to changes in the minimum night temperature at ground level than at 30 ft.

Mean night temperature

To examine whether the minimum night temperature or the mean night temperature was more related to the activity of the night-flying Diptera, the minimum night temperature in the 3-term partial regression on the minimum night temperature, previous day maximum temperature and wind was substituted for the mean night temperature. The results of the analysis are given in Table IV for the lower trap and in Table V for the upper one.

The regressions on the mean night temperature were positive for the two traps in all seasons except in the autumn of the two years for the upper trap. However, these latter regressions were statistically non-significant.

'' For the lower trap, regressions were significant at or less than 0.001 level of probability in the autumn, winter and spring of the two years. Summer regressions, on the other hand, were non-significant. Significant regressions for the upper trap were obtained in the winter and the spring of the two years and the summer of 1957.

The "All Months" and the "Two Years" regressions were all positive and highly significant at less than 0.001 level of probability for the two traps in the two years.

Maximum effect of the mean night temperature occurred in the winter of 1957 for the lower trap and the spring of 1957 for the upper trap, and the regression coefficients were $+0.167 \pm 0.049$ and $+0.110 \pm 0.023$, respectively. Minimum effect was obtained in the summer of 1956 for the lower trap, and the autumn of 1955, for the upper trap, and the regression coefficient values were $+0.014 \pm 0.024$ and -0.003 ± 0.026, respectively.

When the regression coefficients of Diptera on the minimum night temperature and those on the mean night temperature are compared, it is seen that the values for the mean night temperature were always higher than those on the minimum night temperature in all seasons of the two years for both traps, which perhaps indicates that the effect of the mean night temperature on Diptera is rather greater than that of the minimum night temperature.

Effect of the daily range of temperature

In order to test whether the difference between the maximum and minimum night temperature of the day, i.e. the daily range, may have an effect upon the activity of the night flying Diptera, the partial regressions of this group of insects on the daily range of temperature were calculated. This was carried out by substituting for the daily range in the equation : $B = b_2 - b_1$ (Where B is the regression coefficient on the daily range temperature, and b_2 and b_1 are the regression coefficients on the maximum day and minimum night temperatures already calculated). The standard error of the daily range of temperature (S_B) is calculated from the relation : $S_B = S \sqrt{c_{11} + c_{22} - 2c_{12}}$; where S is the standard error of the partial regression on the minimum and maximum temperatures and c_{11}, c_{22}, c_{12} are the c-multipliers of these two factors

The results are given in Tables IV and V. Although the regressions were highly significant in nearly all seasons of the two years at both levels (except the non-significant value of the "All Months" of

the second year in the lower trap and in autumn 1955 in the upper one), no definite relationship could be found between the daily range of temperature and the activity of Diptera at night in either trap. Some months gave negative regressions while others gave positive ones. The same conclusion was also arrived at by WILLIAMS (1940) and EL-ZIADY (1954) in England.

Effect of wind

The regression coefficients were negative for the two years at both levels (Tables IV and V). Therefore, increase in the wind velocity used to cause a reduction in the activity of the night flying Diptera.

For the lower trap, seasonal regressions were highly significant in all seasons of the two years except in the summer of 1956 and the winter of 1957 in which the effect of the wind was non-significant. For the upper trap, on the other hand, regressions were highly significant at or less than 0.001 level of probability except in the summer of 1956 in which it was only significant at the 0.05 level. The "All Months" and the "Two Years" regressions were all negative and were highly significant.

Maximum effect of the wind occurred in the spring of 1956 for the lower trap and winter 1957 for the upper trap (regression coefficients were -0.226 ± 0.022 and -0.247 ± 0.074, respectively). Doubling the catch of Diptera in these seasons would have been brought about by a decrease of 0.6 and 1.1 miles per hour in the wind velocity for the lower and upper traps, respectively. Minimum effect, on the other hand, occurred in the summer of 1956 for the two traps when the regression coefficients were -0.059 ± 0.031 at ground level and -0.056 ± 0.027 at 30 ft.

Regression coefficients for the lower trap were higher than those for the upper trap in all seasons except in winter when the reverse took place. The average regression coefficient for each year as well as of the two years together were also higher for the lower trap. This may indicate that the effect of variations in the wind speed is much more pronounced on the population at ground level than at the upper level.

Effect of relative humidity

As it was not possible to measure the relative humidity at 30 ft. high, this factor was analysed only with regard to catches of the lower

trap. Seasonal regressions are all positive except in the autumn of 1955 and in the summer of both years (Table IV). "All Months" regressions were also positive but the "Two Years" was negative. Regressions, either positive or negative, were non-significant except those of the spring of 1956 and summer 1957 which gave significant values.

Effect of pressure

Computation of the partial regression of this factor was carried out from a 5-term regression for the lower trap (including maximum and mean temperatures, wind and R.H.) and a 4-term regression for the upper trap (including maximum and mean temperatures and wind).

No consistent relationship could be traced between the effect of variation in atmospheric pressure and the flight activity of Diptera at night as some of the seasons yielded positive regressions while others gave negative regressions (Tables IV and V). This, together with the non-significance of the regressions in almost all seasons, may indicate that the pressure has only but a slight effect on the night flying Diptera.

Analysis of variance

Consideration of Table VI shows that for both traps in the various seasons of the two years, the 3-factors regression of Diptera on the maximum and mean temperatures and wind gave the highest percentage of explained variance, except in very few seasons when the explained variance due to other combinations of factors was more than that of the combination containing the mean night temperature. For example, the maximum explained variance for the lower trap was 59.7%, this occurred in the spring of 1955-56 and was due to the combination of the previous day maximum temperature, the minimum night temperature and wind. This corresponded to a maximum explained variance of 55.0% due to the previous day maximum temperature, the mean night temperature and wind, with a difference of 4.7% between the two different combinations which might not be significant. For the upper trap, the maximum percentage of explained variance of 51.5% occurred in the winter of 1955-56 and resulted from the combination of the previous day maximum temperature, the mean night temperature and the wind velocity.

TABLE VI

Seasonal percentage of variance explained by different combinations of the weather factors for Diptera in the night catch.

	Year	Autumn	Winter	Spring	Summer	All months	Two years
Lower trap							
2 factors (max. temp. and wind)	55-56	38.1	14.2	41.9	11.2	33.2	31.4
	56-57	47.5	17.1	35.4	33.5	28.6	
3 factors (max. temp., min. temp. and wind)	55-56	37.3	32.0	59.7	10.8	37.2	34.8
	56-57	47.3	30.6	39.3	35.4	30.9	
3 factors (max. temp., mean temp. and wind)	55-56	44.6	36.1	55.0	10.3	42.8	38.0
	56-57	53.4	39.6	51.4	35.9	40.4	
4 factors (max. temp., mean temp., wind and R.H.)	55-56	44.2	36.0	58.4	12.6	41.9	38.1
	56-57	54.8	39.7	51.5	41.8	40.9	
5 factors (max. temp., mean temp., wind, R.H. and pressure)	55-56	44.3	40.4	58.4	11.6	42.5	38.3
	56-57	54.2	38.6	50.7	43.7	40.6	
Upper trap							
2 factors (max. temp. and wind)	55-56	20.1	48.3	20.2	14.7	29.1	26.1
	56-57	42.8	19.2	24.5	8.6	22.1	
3 factors (max. temp., min. temp. and wind)	55-56	18.6	47.7	31.9	14.2	30.3	27.3
	56-57	42.5	27.7	26.6	9.4	22.8	
3 factors (max. temp., mean temp. and wind)	55-56	18.6	51.5	30.6	16.8	32.1	30.9
	56-57	42.1	31.3	40.6	12.7	30.0	
4 factors (max. temp., mean temp., wind, and pressure)	55-56	17.0	51.2	34.5	15.7	32.8	31.8
	56-57	42.9	39.4	40.3	12.2	30.9	

Winter 1956-57 is represented by December 1956 only. — Autumn 1955-1956 for the upper trap is represented by October and November.

Minimum amount of explained variance, on the other hand, occurred in the summer of 1955-56 for the lower trap (10.3%) and was accounted for by the maximum temperature, mean night temperature and wind ; and in the summer of 1956-57 for the upper trap (8.6%) and was accounted for by the 2-factors regression on the maximum temperature and wind.

DISCUSSION

Effect of temperature

Partial regressions showed positive correlations between the flight activity of Diptera at night and both the previous day maximum temperature, the mean night and the minimum night temperatures in almost all seasons of the two years. These regressions were more pronounced in winter and spring, and they were either significant or highly significant in these two seasons as compared with those of the autumn and summer. The positive significant effect of the mean night temperature on the activity of nocturnal insects has been shown by several investigators, e.g. COOK (1921) with Lepidoptera particularly Noctuidae, HERVEY and PALM (1935) and BEALL (1938) with *Pyrausta nubilalis* Hubn., BRIAN (1947) with *Agrotis obscurus*, HOSNY (1953) with various Macrolepidoptera and EL-ZIADY (1954) with Diptera.

The effect of the mean night temperature seemed to be greater than that of either the maximum day or the minimum night temperatures as the regression coefficients on the mean night temperature were almost always higher than those of the previous day maximum and minimum night temperatures in all seasons of the two years for both traps. Also the maximum day temperature seemed to be more related to the activity of the night flying Diptera than the minimum night temperature. The relative importance of these three temperatures differed among the different groups of insects. BROADBENT (1947) demonstrated the significant effect of the day maximum temperature on aphids caught by light traps, more than either the minimum or the mean night temperatures. The same was also found by BANKS (1952) on Hemerobiidae and EL-ZIADY (1954) on Diptera, caught with suction traps. BANKS explained this effect by supposing that the maximum temperature affected the number of adults emerging the day before, and concluded that "even the night-to-night changes in catch could not be considered as reflecting only changes in flight activity". EL-

ZIADY, taking into consideration the findings of WILLIAMS (1935 and 1939) that Diptera were mostly active in the first part of the night, brought forward the possibility that the maximum temperature is more effective as it occurs late in the afternoon while the minimum temperature occurs late at night. On the other hand, PINCHIN and ANDERSON (1936) and ROBERTSON (1939) found that the activity of the Tipulinae at night was definitely favoured by a high minimum temperature and that the maximum temperature had relatively little effect. This is in accordance with the conclusions of WILLILMS (1940) and SINGH (1952) for all insects caught by light traps and suction traps respectively. BEALL (1938) had not found any correlation between the maximum day temperature and the number of *Pyrausta nubilatis* at night.

The daily range of temperature did not show a definite relationship with the activity of Diptera at night in either traps as indicated by the irregular positive and negative regressions obtained although they were highly significant in most seasons. WILLIAMS (1940) and EL-ZIADY (1954) also proved the non-significance of the effect of the daily range of temperature on the activity of the night flying insects. ROBERTSON (1939), however, found that the activity of Tipulinae was favoured by a small daily range.

Effect of wind

Wind seemed to be the most important factor affecting the activity of Diptera. It showed consistent negative correlations which were highly significant in nearly all seasons. Also the regression coefficients on the wind were considerably higher than those for any other factor. BEALL (1938) found a consistent moderate negative correlation between the numbers of *Pyrausta nubilalis* Hubn. attracted to light and the evening wind although STIRRETT independently in the same year and with the same insect concluded that wind velocities at least up to 17 m.p.h. had not any effect upon its flight. BANKS (1952) found no association between the night catches of Hemerobiidae in the suction traps and the wind speed which was very low (0.30-1.17 m.p.h., mean 0.85 m.p.h.). On the other hand, a significant negative effect of wind was shown by WILLIAMS (1940) for all insects and BROADBENT (1947) for aphids caught by a light trap, also by SINGH (1952) and EL-ZIADY (1954) with suction traps catches of all insects and Diptera, respectively. The latter author, however, added that the effect was greater at 30 feet than at ground level.

Effect of relative humidity and barometric pressure

These two factors are likely to exert but a slight effect on the night flying Diptera as indicated by the inconsistency and non-significance of the correlations obtained with them. The effect of relative humidity was best illustrated by Cook (1921) who found that it was the most important factor affecting the activity of nocturnal Lepidoptera especially Noctuidae. Catches of these insects increased with increasing relative humidity up to 54% after which the catch decreased. Williams (1940) stated that R.H. at 9 p.m. showed a small but probably significant regression with nocturnal insects. El-Ziady (1954) showed that R.H. reduced the activity of the night flying Diptera at ground level in the spring and increased in the autumn, but little effect was noticed in summer. On the other hand, no significant effect of relative humidity could be found by Ainslie (1917) on Crambid moths, Beall (1938) and Stirrett (1938) on *Pyrausta nubilalis,* and Singh (1952) on all insects caught by suction traps at night. Beall, however, stated that the great fluctuations of temperature masked any effect of humidity.

Most of the results on the effect of pressure on the activity of insects are conflicting that no definite conclusions could be obtained. Parman (1920) and Worthley (1932) observed an increased flight activity in some nocturnal insects during times of high pressure. Williams (1940) showed that poor catches were obtained in the light traps when the barometer was low or when the barometer was high but falling. Catches above normal were obtained with a high barometer that was steady or rising and with a medium (normal) barometer. On the other hand, the non-significant effect of barometric pressure on the activity of nocturnal insects has been demonstrated by Cook (1921) in Lepidoptera, Stirrett (1938) in *Pyrausta nubilalis* Hubn., Broadbent (1947) in aphids and Hosny (1953 and 1955) in Macrolepidoptera.

Analysis of variance

The percentage of variance accounted for by different combinations of the weather factors considered showed that the highest percentages were more or less due to the combined effect of the previous day maximum temperature, the mean night temperature and the wind velocity. Other factors such as the relative humidity and barometric pressure either contributed very little to the explained variance or

even caused reduction in its value. The percentage explained by the three above mentioned factors ranged from a minimum of 10.3% in summer to a maximum of 55.0% in spring for the lower trap, and from 12.7% in summer to 51.5% in winter for the upper one.

SUMMARY AND CONCLUSION

The mean wind velocity at night is the most important factor affecting the activity of the nocturnal Diptera. It showed consistent negative and highly significant regressions in nearly all seasons. On the other hand, the previous day maximum temperature, the minimum night and the mean night temperatures gave positive regressions in almost all seasons ; they were more pronounced in the winter and the spring and were either significant or highly significant compared with those of the autumn and the summer. The effect of the mean night temperature seemed to be more great than that of the maximum day temperature. However, the day maximum temperature tended to show more relation to the activity of Diptera than the minimum night temperature. No definite consistent correlations with the daily range of temperature were obtained, the regressions on this factor were highly significant.

Relative humidity and barometric pressure seemed to exert only a slight effect on the night flying Diptera.

Highest percentage of explained variance was mainly due to the combined effect of the previous day maximum temperature, the mean night temperature and the wind velocity.

ACKNOWLEDGEMENTS

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INVESTIGATIONS INTO THE RELATION BETWEEN LUNAR PERIODICITY AND THE ACTIVITY OF DIPTERA IN EGYPT

(with 2 Text-Figures and 4 Tables)

by SAMIRA EL-ZIADY, M.SC., PH.D., F.R.E.S.

and M. F. H. OSMAN, M.SC., PH.D.,

Department of Entomology, Faculty of Science, Cairo University.

INTRODUCTION

Lunar periodicity was observed by some authors to affect the activity of certain aquatic insects such as the May-flies which tend to emerge and swarm in great numbers at or near full moon (HORA, 1927 and HARTLAND-ROWE, 1955). Few nocturnal Lepidoptera, on the other hand, were less active on nights with full moon and there was a belief among amateur entomologists that it is little use hunting for these insects on a night with the moon near full because few numbers will be flying around.

From light trap samples of nocturnally active insects a definite lunar periodicity in the number, with low catches at or near full moon and high catches in the new moon periods (PAGDEN, 1932, in the tropics ; WILLIAMS, 1936 and 1940, and HOSNY, 1953, in Britain) was obtained and in some cases (WILLIAMS, 1940) the geometric mean catches of insects in the new moon week were two to four times those in the full moon week.

The majority of the above authors used light traps for their catches and it was thus thought that the effect was more likely to be

·an artifact due to the reduction of the trap efficiency at full moon because the brightness of the light of the trap on these nights would be less relative to the illumination of the surrounding area compared with nights of new moon.

When suction traps were used to collect insects at night (WILLIAMS and SINGH, 1951), a regular cycle with nearly four times as many insects, on an average, in the new moon weeks as in the full moon weeks was obtained in the five lunar months studied.

The result lead to the supposition that the moonlight may exert an effect on the actual numbers of the population which seemed unlikely ; or a direct effect on their activity resulting in fewer insects being active at times of bright moonlight ; or an effect on their flying habit, i.e. at full moon the insects might be flying either in shaded areas or at higher level in the air thus reducing the population density active near the ground.

Two suction traps, one set up in a wood and another in an open area (SINGH's experiment, 1951) and two other similar traps, one set up at 5 ft, and the other at a level of 30 ft. above the ground (EL-ZIADY's experiment, 1952 and 1953) were used to verify the third assumption and it was found that no definite cyclic difference between the catches of the traps was obtained (WILLIAMS, SINGH and EL-ZIADY, 1956). This work was carried out in England where most of the nights were cloudy, this factor masks the effect of the moon and is very difficult to eliminate in the analysis.

Thus it was desirable to verify further the assumption that the moon had a periodicity on insects causing them to be active at a higher level when full, another experiment such as that of the senior author (1952-53) was carried out in Egypt where the sky is rarely cloudy, and the full moon nights are always bright in contrast to new moon nights.

Two suction traps were used, one set up at 5 ft. and the other at 30 ft. above ground level (the traps and the trap environment are described elsewhere, EL-ZIADY and OSMAN, 1961).

The analysis was carried out on 19 lunar months for the catches in the lower trap and on 18 months for the catches in the upper trap. In this analysis Diptera was the only order considered because it dominated all the other orders in the night catch.

The log. catches for each lunar month were first corrected for the effect of the different weather factors (WILLIAMS, 1935) and were then divided into four categories in accordance with the four phases, each

of which contained seven days with the day of the lunar phase in the middle. The mean for each phase within a cycle was calculated and all the resulting means were used as basis for the analysis. These are shown in Tables I and II for the lower and the upper traps. The figures were finally smoothed to a 5-day running mean to eliminate as far as possible the time trend.

Effect of the moonlight on the activity of Diptera near the ground

At 5 ft., of the lunar months analysed, the maximum number of Diptera was obtained in four months in the new moon period, six months in the first quarter, six months in the full moon period and seven months in the last quarter (Table I).

TABLE I.

Mean log. catch per night for each phase within the lunar cycles of two years (Lower trap).

Month	Year	N.M.	F.Q.	F.M.	L.Q.	Mean
October	1955	2.57	2.89	2.73	2.31	2.63
November		2.38	2.48	2.37	1.85	2.25
December		1.36	1.63	1.67	1.31	1.49
January	1956	1.16	1.74	1.81	2.05	1.69
February		1.89	1.80	1.91	1.86	1.87
March		1.69	1.68	1.78	2.23	1.85
April		2.67	2.69	2.64	2.68	2.67
May		2.46	2.39	1.97	2.15	2.24
June		2.65	2.52	2.44	2.48	2.27
July		2.56	2.37	2.70	2.93	2.64
September		2.64	2.69	3.03	2.96	2.83
October		2.66	2.73	2.73	2.49	2.65
December		1.18	1.82	2.13	1.56	1.67
March	1957	2.01	2.24	2.11	1.91	2.07
April		2.22	2.56	2.19	2.75	2.43
May		2.49	2.81	2.60	2.44	2.59
June		2.34	2.62	2.57	2.65	2.55
July		2.48	2.72	2.74	2.93	2.72
August		3.12	3.06	2.82	2.79	2.95
Mean		2.24	2.39	2.37	2.33	2.33
Antilog.-1		173	245	233	213	213

However, it is noticed that in April 1956, the four phases had nearly the same average of Diptera, and the highest geometric mean catch of 245 insects occurred during the first quarter (Table I).

Examination of Figure 1, shows that there were two peaks of activity of Diptera. The first and the larger peak occurred at a period near the end of the first quarter and the beginning of full moon, while the second and smaller peak occurred in the last quarter with a large dip at new moon week. However, when examining the average catch
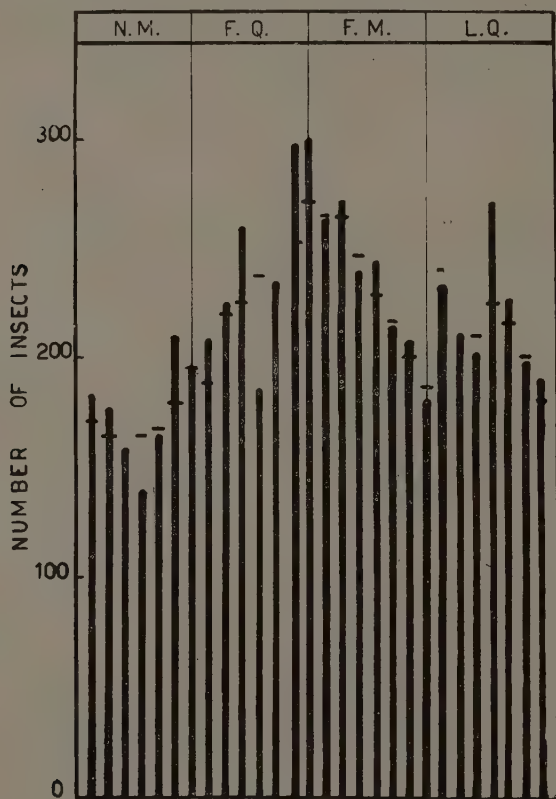

FIG. 1: Mean number of Diptera (antilog.-1) caught per night in the lower trap in 19 lunar months. Broken line (- -): the smoothed 5-day running mean.

of Diptera at each phase (Table II), it was found that the difference between the catches of any two of the lunar cycles was not significant, as the analysis of variance in Table III shows.

TABLE II.

Mean log. catch and antilog-1 of Diptera caught at the 4 phases.

	N.M.	F.Q.	F.M.	L.Q.	Mean
Mean log. catch per night	2.24	2.39	2.37	2.33	2.33
Antilog.-1	173	245	233	213	213

TABLE III.

Analysis of variance.

	D.F.	S.S.	M.S.	S.E.
Month	18	13.6694		
Quarters	3	0.2549		
Residual	54	2.4994	0.0463	0.2152
Total	75	16.4237		

Means of the four quarters :

N.M.	F.Q.	F.M.	L.Q.	Mean	S. of Mean
2.24	2.39	2.37	2.33	2.33	0.0494

Difference between F.M. and N.M. = 0.13 ; Standard error of difference = 0.6698 ; t = 1.862 ; p = 0.1-0.05.

This result shows that the difference between full moon catches and new moon catches of Diptera is statistically non significant, also the difference between the catches of the first quarter, with the maximum mean number of insects and the new moon period with minimum mean number of Diptera is none significant, indicating no lunar periodicity near the ground.

Effect of moonlight on the activity of Diptera at 30 ft.

The sequence of the catches of Diptera in the four phases of the moon in the upper trap during the 18 lunar months are shown in Table IV.

TABLE IV.

Mean log. catch per night for each phase within the lunar cycles of two years (Upper trap).

Month	Year	N.M.	F.Q.	F.M.	L.Q.	Mean
October	1955	2.05	2.26	2.04	1.97	2.08
November		1.81	2.07	1.74	1.48	1.78
December		1.25	1.25	1.27	0.67	1.11
January	1956	0.74	1.41	1.56	1.63	1.34
February		1.48	1.53	1.82	1.69	1.63
March		1.45	1.31	1.32	2.05	1.53
April		2.10	2.17	2.20	2.31	2.20
May		2.06	2.11	1.70	2.06	1.98
June		2.39	2.20	2.27	2.25	2.28
July		2.21	2.10	2.58	2.47	2.34
October		2.27	2.32	2.23	1.95	2.19
December		1.13	1.12	1.18	0.75	1.05
March	1957	1.79	1.97	1.76	1.46	1.75
April		1.85	2.09	1.49	2.19	1.91
May		1.82	2.15	1.87	2.11	1.99
June		1.92	2.22	1.99	2.36	2.12
July		2.24	2.60	2.57	2.91	2.58
August		2.66	2.49	2.28	2.26	2.42
Mean		1.85	1.97	1.88	1.92	1.90
Antilog.-1		70	92	75	82	78

Only two months showed maximum mean log. catch of Diptera during the new moon period, four months during the full moon, and six months had the maximum mean catch and occurred both in the first and the last quarter. The highest total geometric mean catch of Diptera (92 insects), similar to that near the ground, occurred during the first quarter. The difference between catches at any two of the lunar phases, however, was not significant as shown by the following analysis of variance :

	D.F.	S.S.	M.S.	S.E.
Month	17	13.0491		
Quarters	3	0.1424		
Residual	51	2.7435	0.0538	0.2319
Total	71	15.9350		

Means of Quarters :

N.M.	F.Q.	F.M.	L.Q.	Meán	S.E. of Mean
1.85	1.97	1.88	1.92	1.90	0.0547

Full moon-New moon $= +0.03$; S.E. of the difference $= 0.0773$;
$t = 0.388$; $p = 0.7$.
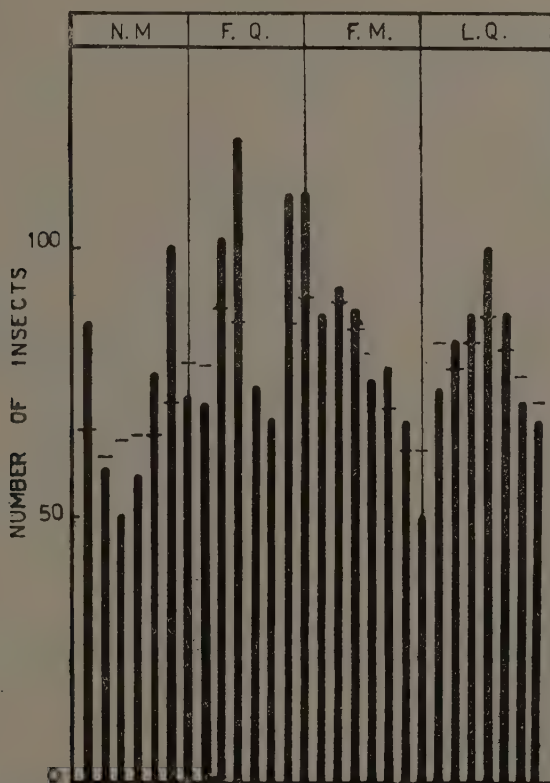
FIG. 3: Mean number of Diptera (antilog.-1) caught per night in the lower trap in 18 months. Broken line (- -): the smoothed 5-day running mean.

Figure 2 shows the mean number of insects caught during a lunar month did not give a definite sequence of the catches while the 5-day running mean showed two peaks similar to those resulted in the catches for the lower trap.

The results indicate also that at 30 ft. Diptera similar to ground level did not show any lunar periodicity.

From the foregoing analysis it can be seen that either at 5 ft. or at 30 ft. level, no definite cyclic difference of the catches existed, a result in good agreement with that arrived at in England by WILLIAMS, SINGH and EL-ZIADY (1956).

SUMMARY

Two suction traps, one at 5 ft. above ground level and the other at 30 ft., were set up in the Entomological Field Station, Faculty of Science, Cairo University, to examine the lunar periodicity in the activity of the night flying Diptera.

Of the 19 lunar months analysed for the catches in the lower trap, maximum numbers of Diptera were obtained in four months in the new moon period, six months in the first quarter, six months in the full moon period and seven months in the last quarteer. A large peak of activity occurred near the end of the first quarter and the beginning of full moon. Of the 18 lunar months for the upper trap two months during the new moon period showed maximum activity of Diptera, four months at full moon and six months at either the first or the last quarter. The difference between the catches of any two phases either near the ground or at 30 ft. high were statistically non-significant. This indicates that there was no lunar periodicity in Diptera.

ACKNOWLEDGMENTS

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EINE NEUE CYDNIDENGATTUNG AUS DEM TSCHADSEE–GEBIET

[*Hemiptera-Heteroptera : Cydnidae*]

(mit 1 Abbildung)

von EDUARD WAGNER, Hamburg.

TSADOCYDNUS nov. gen.

(Typ. gen. : *T. franzi* nov. spec.)

Gestalt klein und oval (Fig. a), 1,67× so land wie breit. Ränder des Kopfes, des Pronotum und der Halbdecken mit feinen, langen Haaren besetzt. Kopf (Fig. b + c) kurz, stark geneigt, fast viereckig, vorn stumpfwinklig. Ränder der Wangen aufgebogen, mit langen Haaren, aber ohne Dornen. Augen von oben gesehen kegelförmig vorstehend. Ozellen deutlich, dem Auge näher als der Mittellinie des Kopfes. Wangenplatten (Fig. c) hoch, ihr unterer Rand gerundet. Rostrum kurz, die Mitte der Mittelbrust etwas überragend ; 2. Glied sehr dick. Scutellum deutlich kürzer als breit, distal gerundet. Corium kurz, sein Hinterrand geschweift. Membran deutlich grösser als das Corium (Fig. a), aber das Ende des Abdomens nich erreichend. Fühler (Fig. d) kurz, die Glieder kräftig ; das 2. Glied ist das kürzeste von allen und deutlich kürzer als das 3. Mittel- und Hinterbrust mit matten Flächen. Ablaufrinnen der Stinkdrüsen (Fig. f) auf einer glänzenden, hommaförmigen Schwiele gelegen. Schenkel einfach, nur mit einzelnen Haaren. Schienen bedornt, Vorderschiene (Fig. e) distal verbreitert, mit kräftigen Dornen. Tarsen auch bei den Vorderbeinen am Ende der Schiene entspringend.

Genitalien des Männchen von denen der übrigen Gattungen stark abweichend. Genitalgriffel (Fig. h) keulenförmig, mit langer, schlanker Hypophysis. Penis (Fig. i) kurz und dick, birnförmig.

Tsadocydnus nov. gen. muss wegen des kurzen, breiten Scutellums und des auffallend kleinen Corium (Fig. a) in die Nähe von *Cydnus* F. (*Brachypelta* Am. et Serv.) und *Cydnopeltus* Sign. gestellt werden. Er unterscheidet sich von *Cydnus* F. durch die kleine, ovale gestalt, gewölbtes Pronotum, den behaarten Kopfrand, das auffallend kurze 2. Fühlerglied und den nach aussen gebogenen Aussenrand des Corium. Sehr stark ist auch der Unterschied im Bau der Genitalien, besonders in der Gestalt der Genitalgriffel. *Cydnopeltus* Sign. ist gleichfalls bedeutend grösser, der Rand der Wangen ist nicht aufgebogen und nicht mit Haaren besetzt, die Fühler sind länger und schlanker, das 1. Glied ist auffallend dick und das Rostrum erreicht die Mittelhüften.

Dagegen stimmen alle 3. Gattungen im Bau der Ablaufrinnen der Stinkdrüsen und in dem stark verdickten 2. Glied des Rostrum überein. Diese beiden Merkmale, sowie das kurze, breite Scutellum und das sehr kleine Corium unterscheiden sie von den übrigen Gattungen der Cydnidae.

Tsadocydnus franzi nov. spec.

Schwarz, glänzend, mit kräftigen Punktgruben, die regelmässig, aber nicht sehr dicht stehen. Clavus und Corium hell ockergelb ; die Spitze des ersteren und ein Fleck an der Spitze der Kubitalader des letzteren braun. Membran milchweiss. Fühler und Beine schwarzbraun bis braun, 1. und 2. Fühlerglied sowie die Tarsen gelb.

Kopf (Fig. b + c) deutlich breiter als lang, stark geneigt, oberseits ziemlich gleichmässig punktiert. Scheitel $3,7 \times$ so breit wie das kurze, breite Auge. Wangenplatten sehr hoch, ihr unterer Rand stark gekrümmt. Fühler kurz, die Glieder mit Ausnahme von Glied 2 kräftig ;
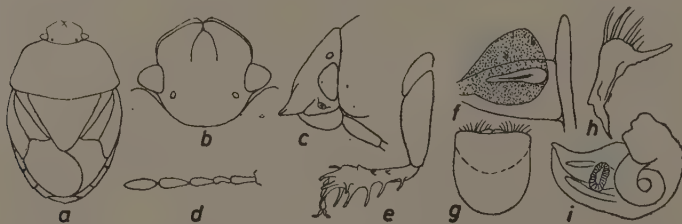
Tsadocydnus franzi nov. spec.: a = Weibchen (9×), b = Kopf des Weibchen schrag von vorn (25×), c = derselbe seitlich (25×), d = Fühler des Männchen (25×), e = Vorderbein des Männchen (25×), f = Mittel- und Hinterbrust des Männchen (53×), g = Genitalsegment des Männchen von hinten (25×), h = Genitalgriffel von oben (67×), i = Penis von rechts (53×).

letzteres 0,67× so lang wie Glied 1 ; 3. Glied so lang oder kaum länger als das 1. ; das 4. Glied 1,13× so lang wie das 3. ; das 5. Glied 1,25× - 1,30× so lang wie das 4., alle Glieder mit feinen, hellen Haaren.

Pronotum (Fig. a) stark gewölbt, Schwielen undeutlich, Vorderrand leicht eingebuchtet, hinter der Einbuchtung eben. Seitenrand schwach geschweift, Hinterrand gleichmässig nach aussen gebogen. Scutellum leicht gewölbt, kräftig punktiert, distal den Clavus weit überragend und breit abgerundet. Halbdecken mit groben, ziemlich weit von einander entfernten braunen Punktgruben ; Adern etwas erhaben. Hinterrand des Corium (Fig. a) fast winglig eingebuchtet. Membran mit feinen, bräunlichen Adern. Rükken schwarz.

Unterseite schwarz, glänzend, mit kräftigen Punktgruben und nur einzelnen, langen Haaren bedeckt. Ablaufrinne der Stinkdrüsen (Fig. f) flach, nach aussen allmählich werdend, auf einer schwarzen, glänzenden Schwiele liegend. Matte Flächen der Mittel- und Hinterbrust mit stark gerundeten Ecken. Rostrum kurz und kräftig ; das 1. Glied liegt ganz zwischen den grossen Wangenplatten ; 2. Glied sehr dick, länger als das 3. ; die Spitze reicht bis zu 2/3 der Lange der Mittelbrust. Beine schwarzbraun. Schenkel unbewehrt, mit einzelnen langen Haaren. Schienen mit kräftigen Dornen. Vorderschiene (Fig. e) distal verbreitert, an der Aussenkante 6 kräftige Dornen, an der Innenkante nur Höcker oder Zähne.

Genitalsegment des Männchen (Fig. g) klein, proximal gerundet, distal fast gerade abgestutzt. Genitalgriffel (Fig. h) gegen die Spitze verdickt, dort gerundet und fast keulig. Hypophysis lang und schlank, schräg auf dem Paramerenkörper sitzend, ihre innere Kante mit höckerartigen Zähnen. Paramerenkörper distal lang behaart. Penis (Fig. i) kurz und dick, birnförmig, schwach pigmentiert. Sekundäre Gonopore etwa in der Mitte.

Länge : Männchen = 2,75 mm, Weibchen = 3,00 mm ; Breite : Männchen = 1,67 mm., Weibchen = 1,82 mm.

Ich untersuchte 1 Männchen und 1 Weibchen aus dem Tschadsee-Gebiet : Tschimba bei Deressia, Distrikt Lai 7.4.57, H. FRANZ leg.

Ich widme diese Art ihrem Sammler, Herrn Prof. Dr. H. FRANZ, Wien.

Holotypus in meiner Sammlung, Allotypoid in der Sammlung H. FRANZ in Wien.

Mein Dank für liebenswürdige Unterstützung bei dieser Arbeit gilt den Herren Prof. H. FRANZ, Wien, und G. SEIDENSTUCKER, Eichstätt.

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Xylocoris heluanensis nov. spec.,

EINE NEUE ANTHOCORIDEN–ART AUS AEGYPTEN

[*Hemiptera-Heteroptera : Anthocoridae*]

(mit 1 Abbildung)

von EDUARD WAGNER, Hamburg.

Xylocoris heluanensis nov. spec.

Gestalt klein, verhältnismässig schlank, das Männchen 3,3×, das Weibchen 3,25× so lang wie das Pronotum breit ist. Glänzend. Schwarz bis schwarzbraun, die Spitze des Kopfes oft rotbraun. Oberseite mit feinen, kurzen, gelblichen Haaren bedeckt.

Kopf (Fig. c + d) etwas länger als breit, hinter den Augen halsartig verlängert. Scheitel beim Männchen 3,2×, beim Weibchen 3,6-3,8× so breit wie das flache, braune Auge. Ocellen deutlich, dem unteren Augenrand genähert. Fühler schwarzbraun, die Enden der Glieder heller. 1. Glied kurz und kräftig, etwa 2× so lang wie das Auge breit ist ; 2. Glied gegen die Spitze deutlich verdickt, 2,3× so lang wie das 1. und fast so lang wie der Kopf breit ist ; das 3. Glied 0,7-0,8×\ so lang wie das 2. und so lang wie das 4., die beiden letzten Glieder sehr dünn.

Pronotum (Fig. c + d) trapezförmig, Seiten fast gerade, Hinterrand leicht eingebuchtet, beim Männchen 1,7×, beim Weibchen 1,9× so breit wie der Kopf samt Augen. Halsring schmal, aber deutlich. Scutellum (Fig. a) etwa gleichseitig dreieckig, schwarz, glänzend, gewölbt. Clavus braun. Corium weissgelb, der hintere Teil des Exocorium und die Spitze des Mesocorium schwarz, Cuneus einfarbig schwarz (Fig. a). Membran weisslich, durchscheinend. Hinterschiene (Fig. f) deutlich länger als das Pronotum breit ist.

Unterseite glänzend, schwarzbraun. Matte Flächen der Brust-
stücke (Fig. e) mit feiner Punktierung. Ablaufrinne der Stinkdrüsen,
gleichmässig gekrümmt, kurz, den Vorderrand der Hinterbrust bei
weitem nicht erreichend. Rostrum gelb, bie zu den Mittelhüften rei-
chend. Hüften und Beine gelbbraun, mit feinen hellen Haaren. Tibien
verhältnismässig schlank, mit feinen Haaren, die etwa so lang sind
wie die Tibie dick ist, aber ohne deutliche Dornen. Hintertibien (Fig. f)
deutlich länger als das Pronotum breit ist.

Genitalsegment des Männchen (Fig. g) fast dreieckig, mit nach
links gerichteter Spitze. Genitalgriffel (Fig. h) schlank, stark gewun-
den, nach links gerichtet, aber die Spitze des Segments nich erreichend.

Länge : Männchen = 1,45-1,50 mm., Weibchen = 1,70-1,85 mm.
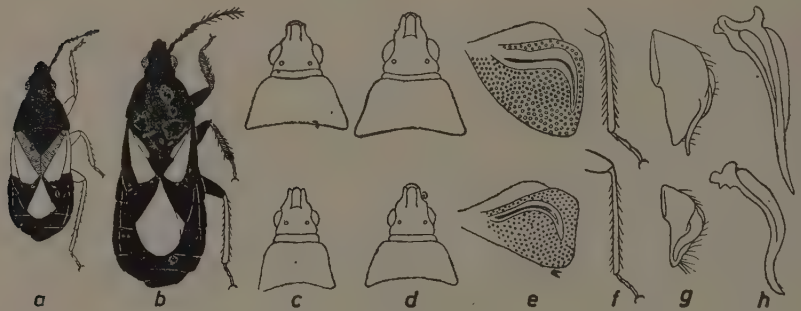
Xylocoris obliquus Costa und *heluanensis* nov. spec.: a = *X. heluanensis*
nov. spec., b = *X. obliquus* Costa, c-h = obere Reihe: *X. obliquus* Costa, untere
Reihe: *X. heluanensis* nov. spec., a+b = Männchen (18×), c = Kopf und Pro-
notum des Männchen (25×), d = dasselbe vom Weibchen (25×), e = Mittel-
und Hinterburst (53×), f = Hinterbein (25×), g = Genitalsegment des Männ-
chen von oben (53×), h = Genitalgriffel von oben (67×).

Xylocoris heluanensis nov. spec. gehört in die Untergattung *Xylo-
coris* s. str. und dort in die Gruppe der Arten, bei denen die Ablau-
frinne der Stinkdrüsen den Vorderrand der Pleuren nicht erreicht (*X.
cursitans*-Gruppe). Die Art, die ihm amnächsten steht, ist *X. obliquus*
Costa. Diese Art ist jedoch von grösserer Gestalt (Fig. b), 1,8-2,4 mm.
lang (die von REUTER angegebene und von STICHEL übernommene Länge
von 1,5-2,4 mm. wurde durch meine Messungen nicht bestätigt), die
mittlere Länge der Art liegt bei 1,9-2,0 mm. *X. obliquus* Costa hat
überdies ein breiteres Auge (Fig. c+d), der Scheitel ist 2,1-2,4× so
breit wie dieses. Das Pronotum (Fig. c+d) ist hinten breiter, das
2. Fühlerglied deutlich kürzer als der Kopf breit ist (0,7-0,8× so lang),
das 3. Fühlerglied ist 0,9× so lang wie das 2. Die Halbdecken sind

dunkler gefärbt. Der Clavus ist schwarz mit Ausnahme eines schmalen Streifens am Coriumrande. Das Mesocorium ist ganz weissgelb, das Exocorium ganz oder fast ganz schwarz mit Ausnahme eines kleinen Fleckes an der Basis (Fig. b). Die Ablaufrinne der Stinkdrüsen (Fig. e) ist fast rechtwinklig gebogen und reicht weiter nach vorn als bei unserer neuen Art. Die Beine sind stets dunkel, nur die Tibien oft hell. Letztere sind überdies kürzer und kräftiger, die Hintertibien höchstens so lang wie das Pronotum breit ist. Zwischen den hellen Haaren der Tibien sind deutlich helle Dornen zu erkennen. Das Genitalsegment des Männchen (Fig. g) ist weit grösser. Genitalgriffel (Fig. h) sehr lang und schlank, weniger stark gekrümmt und die linke Spitze des Segments deutlich überragend.

Der Verdacht, dass es sich bei *X. heluanensis* nov. spec. um eine helle Variante oder Rasse von *X. obliquus* Costa handeln könne, wird widerlegt durch die Form der Ablaufrinne der Stinkdrüsen, den Bau des Genitalien, die Länge der Tibien und die Breite des Auges. Beachtenswert ist auch, dass bei *X. heluanensis* bei sonstiger Aufhellung die Spitze des Mesocoriums schwarz ist, während sie bei dem sonst dunkleren *X. obliquus* stets hell ist. Die Von REUTER aus Süd-Persien beschriebene var. *orientalis* ist noch grösser als *obliquus* und dürfte daher nicht hierher gebören.

Ich untersuchte 2 Männchen und 2 Weibchen aus Aegypten : Heluan 2.3.33, 1 Weibchen, C. KOCH leg. und 10.6.33, 2 Männchen, 1 Weibchen, W. WITTMER leg.

Holotypus und Paratypoid in meiner Sammlung, Allotypoid und Paratypoid in der Sammlung C. MANCINI in Genua.

Das Material dieser Art verdanke ich Herrn CESARE MANCINI, Genua. Ich möchte nicht versäumen, ihm auch an dieser Stelle für sein liebenswürdiges Entgegenkommen noch einmal bestens zu danken.

EINE NEUE REDUVIIDEN–ART AUS AEGYPTEN

[*Hemiptera-Heteroptera*]

(mit 1 Abbildung)

von EDUARD WAGNER, Hamburg

Paramphibolus alfierii nov. spec.

Gestalt klein und lang-oval. Oberseite mit gekrümmten, ziemlich langen, weissen Haaren dicht bedeckt ; ausserdem mit farblosen Punktgruben. Ockergelbbraun und schwarz. Glänzend.

Kopf schwarz, auf dem hinteren Abschnitt ein mittlerer Längsstreif und die Ocellenhöcker gelbbraun. Vorderer Abschnitt mit gelbem Streif am Augenrand ; Tylus nach vorn aufgehellt. Beide Abschnitte von gleicher Länge, der Raum zwischen den Augen breiter als lang (Fig. a). Scheitel 2,0-2,1× so breit wie das gewölbte, graubraune Auge. Ocellen hinter dem inneren Augenrand auf einem Höcker sitzend. Teil des Kopfes hinter den Augen gegen die Basis gleichmässig verjüngt. Scheitel und Stirn (Fig. b) ziemlich eben, durch eine tiefe Furche getrennt. Tylus stark gekrümmt. Auge bis zur Kehle reichend. Fühler braun, schlank, das 1. Glied etwas kürzer als der Kopf breit ist ; 2. Glied 0,70-0,75× so land wie das 1. ; das 3. Glied (ohne Zwischenglied) 0,75× so lang wie das 2. und halb so lang wie das 4. Das 1. Glied des Rostrum deutlich länger als das 2., aber deutlich kürzer als das 2. und 3. zusammen.

Pronotum (Fig. c) ockergelbbraun. Vorderecken mit spitzer, schräg nach vorn gerichteter Turberkel. Vorderer Abschnitt mit 3 tiefen Längsfurchen, die grösstenteils dunkelbraun gefärbt sind. Hinterer Abschnitt mit ausgebreitetem Seitenrand, fast rechtwinkligen Seitenecken und abgerundeten Hinterecken, die kaum nach hinten vorstehen. Mittlerer Teil des Hinterabschnittes stark gewölbt, mit einer Längsfurche. Scutellum (Fig. d) spitz, dreieckig, schwarz, im hinteren Teil eine helle Längsschwiele, die von dem ebenfalls hellen, schwielig

verdickten Seitenrändern überragt wird. Corium gelbbraun, nach
hinten spitz auslaufend. Neben der Analader eine lange dreieckige
Zelle, hinter derselben eine viereckige Discalzelle (Fig. h). Membran
dunkelbraun, das Abdomen beträchtlich überragend, glänzend. Adern
schwarzbraun. Connexivum gelbbraun, mit dunkler Querbinde in der
vorderen Hälfte jedes Segments.
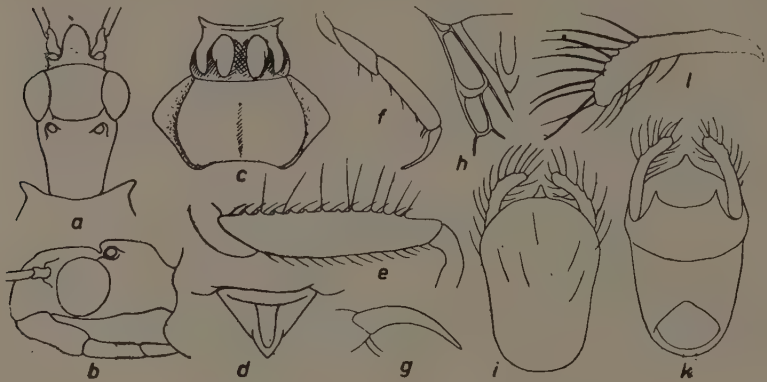
Paramphibolus alfierii nov. spec. (Männchen): a = Kopf von oben (18×),
b = derselbe seitlich (18×), c = Pronotum (12,5×), d = Scutellum (18×),
e = Hinterschenkel (18×), f = Hinterfuss (36×), g = Klaue des Hinterfusses
(72×), h = Anal- und Discalzelle des Corium (18×), i = Genitalsegment von
unten (25×), k = dasselbe von oben (25×), l = Genitalgriffel von oben (53×).

Unterseite schwarz. Brustseiten ohne Tuberkel. Hüftplatten gelb-
braun. Vorderschenkel (Fig. e) schwarzbraun, oberseits mit deutlichen
Tuberkeln, unterseits unbewehrt, aber überall mit langen, abstehen-
den und etwas kürzeren, schrägstehenden, grauen Haaren. Mittel-
und Hinterschenkel gelbbraun, mit dunklen Längsstreifen. Schienen
gelbbraun, Behaarung wie bei den Schenkeln. Tarsen gelbbraun. An
den Hintertarsen (Fig. f) ist das 3. Glied länger als das 1. und 2. zu-
sammen. Klauen (Fig. g) kräftig, mässig gekrümmt, ohne Zahn.

Genitalsegment des Männchen (Fig. i + k) mehr als 1,5× so lang
wie breit, distal verbreitert und abgerundet. Hinterrand der Genital-
öffnung in der Mitte mit kurzem, spitzen Fortsatz. Genitalgriffel
(Fig. 1) lang und dünn, leicht gekrümmt, in der Spitzenhälfte mit
zahlreichen Tuberkeln, die lange Borsten tragen.

Länge : Männchen = 6.7-6,9 mm.; Weibchen unbekannt.

P. alfierii nov. spec. muss wegen des Baues der Vorderschenkel und der Klauen in die Gattung *Paramphibolus* Reut. gestellt twerden. Er unterscheidet sich von den bisher bekannten Arten dieser Gattung durch das 3. Fühlerglied, das kürzer ist als das 2. und als das 4., während es bei den übrigen Arten etwa doppelt so lang ist wie jedes von diesen beiden. Auch das 1. Fühlerglied ist bei unserer neuen Art wesentlich kürzer und nur 0,60-0,67× so lang wie der Kopf. Auch die Grösse ist auffällig. Die beiden anderen Arten sind kleiner, *P. pusillus* Reut. = 4,5 mm., *P. rugosus* Vill. = 5,0 mm. lang.

Ich untersuchte 2 Männchen aus Aegypten: Wadi Um Assad 14.10.34, A. ALFIERI leg. Ich erlaube mir, diese Art ihrem Sammler, dem eifrigen Erforscher der Fauna Aegyptens, Herrn Prof. A. ALFIERI Kairo zu widmen.

Holotypus in meiner Sammlung, Paratypoid in der Sammlung H. PRIESNER, Linz.

Herrn Prof. H. PRIESNER, Linz, der mir die Art zur Untersuchung zur Verfügung stellte, sei auch an dieser Stelle bestens gedankt.

EINE NEUE Maurodactylus–Art AUS ARABIEN

[*Hemiptera-Heteroptera : Miridae*]

(mit 2 Abbildungen)

von EDUARD WAGNER, Hamburg.

Maurodactylus orientalis nov. spec.

Länglich (Männchen) bis länglich-oval (Weibchen), das Männchen 3,5-3,6×, das Weibchen 3,1-3,2× so lang wie das Pronotum hinten breit ist. Hell oskergelbbraun, unterseits oft dunkler (Männchen). Oberseits mit feinen, anliegenden, gekrümmten, hellen Haaren ; ohne dunkle Behaarung. Makropter.

Kopf kurz und breit, von oben gesehen (Fig. 1, a+b) mehr als 2× so breit wie lang. Scheitel am Hinterrande mit kräftigem Kiel, davor eine tiefe Quergrube, die nicht bis zum Auge reicht. Scheitel beim Männchen 1,10-1,15×, beim Weibchen 1,8× so breit wie das runde, grob gekörnte, vorstehende. Von vorn gesehen (Fig. 1, c+d) ist der Kopf beim Männchen 1,3×, beim Weibchen 1,25× so breit wie hoch. Scheitel mit braunen Flecken, Stirn mit ebensolchen Querlinien, Wangen hell, Zügel schwarz, Tylus mit 2 seitlichen, schwärzlichen Längsflecken oder ganz schwarz. Fühlergrube neben der unteren Augenecke. Seitlich gesehen (Fig. 1, e) ist der Kopf geneigt, etwa so lang wie hoch. Stirn stark gewölbt, vom Tylus durch eine tiefe Furche getrennt. Tylus vorstehend, im basalen Teil stark gekrümmt, distal gerade und rückwärts gerichtet. Kehle kurz, deutlich eingebuchtet. Fühler in der Regel schwarz ; 2. Glied bisweilen nur am Grunde schwarz, im übrigen schwarzbraun ; 1. Glied dicker als die übrigen und 0,25-0,30× so lang wie der Kopf samt Augen breit ist, an der Innenseite mit 2 schwarzen Borsten ; 2. Glied beim Männchen 0,88×, beim Weibchen 0,75× so lang wie das Pronotum hinten breit ist ; 3. Glied 0,8× so lang wie das 2. und 2× so lang wie das 4., die beiden letzten Glieder dünner.

Pronotum (Fig. 1, a+b) trapezförmig, nach hinten stark verbreitert und dort 1,35-1,38× so breit wie der Kopf samt Augen. Schwielen deutlich, oft dunkler gefärbt, beim Männchen bisweilen auch die Fläche des Pronotum dunkler. Scutellum etwas breiter als lang. Halbdecken einfarbig hell, Membran hell, durchscheinend, Adern hellgelb.
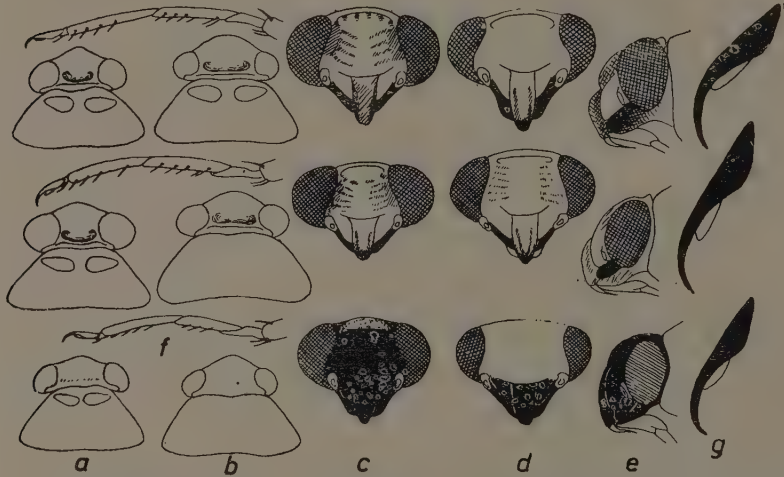
Abb. 1: *Maurodactylus:* Obere Reihe = *M. orientalis* nov. spec., mittlere Reihe = *M. nigrigenis* Reut.; untere Reihe = *M. albidus* Klti. — a = Kopf und Pronotum des Männchen von oben (22,5×); b = dasselbe vom Weibchen (22,5×); c = Kopf des Männchen von vorn (31,5×); d = dasselbe vom Weibchen (31,5×); e = Kopf des Männchen seitlich (31,5×); f = Hinterfuss des Männchen seitlich (47,5×); g = Klaue des Hinterfusses von aussen (190×).

Unterseite beim Weibchen hell, beim Männchen in der Regel dunkel. Rostrum mit schwarzer Spitze, die Mitte der Mittelbrust erreichend. Beine hellgelb, beim Männchen alle Schenkel dunkel, beim Weibchen hell und ungefleckt. Hinterschenkel an der Vorderkante vor der Spitze mit einer kräftigen Borste. Schienen mit schwarzen Dornen, die etwa so lang sind wie die Schiene dick ist und aus winzigen schwarzen Punkten entspringen. Tarsen schlank, schwarz oder schwarzbraun. An den Hintertarsen (Fig. 1, f) ist das 3. Glied 1,05-1,10× so lang wie das 2. und × so lang wie das 1. Das 2. und 3. Glied an der Unterseite mit einigen schwarzen Dornen, die denen der Schienen ähnlich sind. Klauen (Fig. 1, g) sehr lang und sehr schlank, distal stärker gekrümmt, im basalen Teil kaum verdickt. Haftläppchen lang und schmal, der Klaue anliegend.

Genitalsegment des Männchen (Fig. 2, a) schlank, kegelförmig, deutlich länger als breit, mit feinen, langen, hellen Haaren. Genitalöffnung gross. Rechter Genitalgriffel (Fig. 2, b) sehr klein, oval, länger als breit, mit spitzer Hypophysis und wenigen Borsten an der Aussenseite. Linker Griffel (Fig. 2, c) robust, Hypophysis gerade, spitz, mit blattartiger Verbreiterung. Sinneshöcker mit fingerförmigem, distal abgerundetem Fortsatz. Vesika des Penis (Fig. 2, d) sehr lang und dünn, S-förmig gekrümmt, distal mit 2. schlanken Chitinspitzen, von denen die innere etwas länger ist ; sekundäre Gonopore weit vor der Spitze gelegen. Spitzenteil der Theka (Fig. 2, e) sehr lang und schlank, gleichmässig, aber schwach gekrümmt und ebenso gegen die Spitze verjüngt.

Länge : Männchen = 3.15-3.50 mm. ; Weibchen = 2,55-3,40 mm.
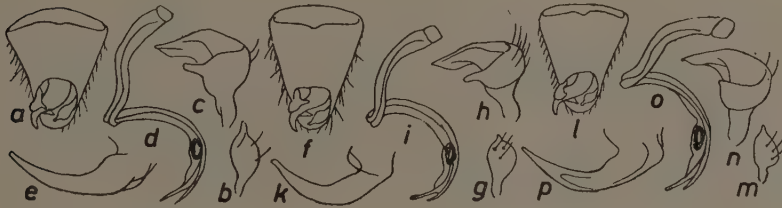
Abb. 2: Genitalien des Männchen: a-e = *M. orientalis* nov. spec.; f-k = *M. nigrigenis* Reut.; l-p = *M. albidus* Klti. — a,f,l = Genitalsegment von oben (31,5×); b,g,m = rechter Genitalgriffel von oben (84×); c,h,n = linker Griffel von oben (84×); d,i,o = Vesika des Penis seitlich (84×); e,k.p = Spitzenteil der Theka seitlich (84×).

M. orientalis n. sp. steht der Art *M. nigrigenis* Reut. sehr nahe. Diese Art ist jedoch grösser und robuster, das Männchen 3,6-3,9 mm., das Weibchen 3,15-3,50 mm. lang, der Scheitel ist beim Männchen (Fig. 1, a) 1,0×, beim Weibchen (Fig. 1, b) 1,6× so breit wie das deutlich grössere Auge ; der Kopf ist niedriger (Fig. 1, c+d). Das Rostrum reicht bis zwischen die Mittelhüften, an den Hintertarsen (Fig. 1, f) ist das 3. Glied 1,1× so lang wie das 2. und die Klauen (Fig. 1, g) sind länger und schlanker. Im Bau der Genitalien des Männchen zeigen sich keine wesentlichen Unterschiede ; das will jedoch wenig besagen, da sie auch bei den übrigen Arten der Gattung nicht anders gebaut sind.

Bei *M. albidus* Klti. ist die Gestalt kleiner, der Kopf in der Regel ganz schwarz, selten beim Weibchen gelblich mit schwarzer Spitze

(Fig. 1, d) oder ganz hell, aber nie fällt die Art durch eine dunkle Kopfspitze mit hellen Wangen auf. Der Scheitel ist beim Männchen 1,7×, beim Weibchen 1,90-1,95× so breit wie das deutlich kleinere Auge (Fig. 1, a + b), der Scheitel zeigt vor dem Hinterrand keine deutliche Quergrube, das Rostrum reicht bis zur Spitze der Mittelhüften, die Furche zwischen Stirn und Stirnschwiele ist viel flacher (Fig. 1, e) und das 3. Glied der Hintertarsen (Fig. 1, f) ist etwa 1,2× so lang wie das 2., die Bedornung der Unterseite der Tarsen ist weit undeutlicher.

Zweifellos hat CARVALHO (1952) recht, wenn er die Gattungen *Maurodactylus* Reuter 1878 und *Campylognathus* Reuter 1890 (=*Ochrodema* Reuter, 1901) zusammenlegt. Es ist aber nicht möglich, der ehemaligen Gattung *Campyloganthus* Reut. innerhalb der Gattung *Maurodactylus* Reut. den Rang einer Untergattung zuzuerkennen, wie STICHEL (1959) es tut. Die Unterschiede zwischen beiden sind so gering, dass sich kein brauchbares Merkmal finden lässt, um sie zu trennen. Der von STICHEL hierfür benutzte Unterschied in der Länge der Glieder der Hintertarsen ist in Wirklichkeit garnicht vorhanden. Man könnte viel eher in der eigenartigen Zeichnung des Kopfes und dem kielartigen Hinterrand des Scheitels ein solches sehen, aber auch diese beiden Merkmale werden durch Übergänge entwertet. Auch der Bau der Genitalien des Männchen stimmt bei allen Arten auffallend stark überein. Wir müssen daher CARVALHO (1952) folgen und die Einteilung der Gattung in Untergattungen fallen lassen.

Die Art *Maurodactylus limbatellus* Puton 1889 muss jedoch, wie der Verfasser kürzlich nachgewiesen hat, aus der Gattung *Maurodactylus* herausgenommen werden. Sie hat ganz anders gebaute Genitalien und Klauen und gehört in eine neu aufgestellte Gattung (*Chinacapsus* E. Wgn.).

Ich untersuchte 26 Männchen und 9 Weibchen aus Saudi-Arabien, die sämtlich in El Riyadh von Dr. DIEHL an Licht gefangen wurden. Auffällig ist, dass dabei auch Weibchen anflogen; 1 Männchen und 1 Weibchen kopulierten sogar am Licht.

Die Fänge wurden in der Zeit vom April 1958 bis zum Mai 1960 gemacht, vor allem aber in den Monaten Februar bis Mai.

Holotypus und Allotypoid in meiner Sammlung, Paratypoide ebenda und in der Sammlung H. ECKERLEIN in Coburg.

Herrn Dr. H. ECKERLEIN, der mir auch dieses Material zuleitete, sei auch an dieser Stelle bestens gedankt!

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EIN WEITERER BEITRAG
ZUR MIRIDEN–FAUNA AEGYPTENS

[*Hemiptera - Heteroptera*]

(mit 3 Abbteilungen)

von EDUARD WAGNER, Hamburg.

1.   Cyrtopeltis (Cyrtopeltis) kochi nov. spec.

Von kleiner, schlanker Gestalt, das Männchen 3,4× so lang wie
das Pronotum breit ist.   Hellgelblich, mit brauner bis schwarzer
Zeichnung.   Oberseite mit kräftigen, halbaufgerichteten, schwarzen
Haaren bedeckt, die etwa so lang sind, wie die Schienen dick sind.
Makropter (Männchen).

Kopf (Fig. 1, a) breiter als lang, Scheitel (Männchen) 1,65-1,70 ×
so breit wie das gewölbte, schwarzbraune Auge.   Stirnschwiele, die
Kopfseiten hinter den Augen und damit vereinigt 2 Flecke am Hinter-
rande des Scheitels, sowie 2 unterbrochene Längsbinden auf der Stirn
schwarzbraun.   Fühler kurz und dick (Fig. 1, b), das 1. Glied schwarz,
an beiden Enden breit weisslich, mit schräg stehenden Borsten, 0,8 ×
so lang wie der Scheitel breit ist ; 2. Glied so dick wie das 1., im basalen
Teil schlanker, mit 2 schwarzbraunen Ringen, der eine nahe der Basis,
der andere vor der Spitze, das Glied etwas kürzer als der Kopf samt
Augen breit ist, fein behaart ; 3. Glied nur wenig schlanker, 0,6 × so
lang wie das 2., schwarz, an der Basis und der Spitze hell ; 4. Glied
kürzer als das 1., oval, einfarbig schwarzbraun.

Pronotum (Fig. 1, a) viel breiter als lang, hinten 1,5 × so breit wie
der kopf samt Augen, Seitenrand stark eingebuchtet. Schwielen deut-
lich, gewölbt, querliegend, den Seitenrand nicht erreichend, bisweilen
braun gefärbt.   Scutellum, im basalen Teil braun, im hinteren Teil
mit brauner Längsbinde.   Halbdecken etwas dunkler gefärbt, in der

hinteren Aussenecke des Corium ein brauner Fleck. Cuneus hell, an
der Spitze breit braun. Membran weisslichgrau, Adern teilweise
bräunlich.

Unterseite mit feiner, heller Behaarung. Rostrum mit schwarzer
Spitze, fast bis zu den Mittelhüften reichend. Beine mit der gleichen
schwarzen Behaarung wie die Oberseite. Schenkel mit kräftigen,
schwarzbraunen Flecken. Schienen am Grunde schwarzbraun. Hin-
terschiene nur 2,2× so lang wie der Kopf breit ist.
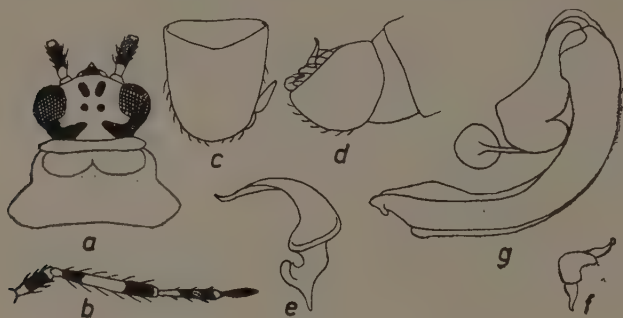
Abb. 1: *Cyrtopeltis (Cyrtopeltis) kochi* nov. spec. (Männchen): a = Kopf
und Pronotum von oben (31,5×); b = Fühler (31,5×); c = Genitalsegment
ventral (31,5×); d = dasselbe von rechts (31,5×); e = linker Genitalgriffel
seitlich (84×); f = rechter Griffel seitlich (84×); g = Penis von rechts (84×).

Genitalsegment des Männchen (Fig. 1, c + d) distal abgerundet,
seitlich gesehen fast kugelig. Genitalöffnung gross, ihre Ränder ohne
Fortsätze. Linker Genitalgriffel (Fig. 1, e) gekrümmt, an der Basis
dick, gegen die Spitze gleichmässig verjüngt und ofne erkennbare
Hypophysis. Rechter Griffel (Fig. 1, f) sehr klein, rechtwinklig ge-
krümmt, mit schlanker, langer Hypophysis. Penis (Fig. 1, g) gross,
Theka schlank, stark gekrümmt, distal spitz. Basis sehr gross. Vesika
ohne Besonderkeiten. Ansatzpalltten gross.

Länge : Männchen = 2,78-2,80 mm.

Bei *C. kochi* n. sp. könnten Zweifel entstehen, ob die Art nicht in
die Gattung *Dicyphus* Fieb. gestellt werden müsste. Die Zeichnung
des Kopfes und die stark gewöbten Schwielen des Pronotum würden
das rechtfertigen. Aber der Bau der Genitalien des Männchen ent-
spricht völlig denjenigen von *Cyrtopeltis* Fieb. Ebenso sind der vorn
gerundete Kopf, der geringe Abstand des Auges vom Vorderrand des

Pronotum und die geringe Länge des 1. Fühlergliedes Merkmale, nach denen die Art zu *Cyrtopeltis* Fieb. gestellt werden muss. Innerhalb diese Gattung stelle ich die Art in die Untergattung *Cyrtopeltis* s. str. Es wäre allerdings zu erwägen, ob hier nicht die Aufstellung eines neuen Subgenus richtiger wäre. Die Art unterscheidet sich von allen übrigen Arten der Untergattung durch die kräftige, schwarze Behaarung der Oberseite und der Beine, die sehr kräftige Fühler und die Zeichnung des Kopfes, die an *Dicyphus* Fieb. erinnert.

Ich untersuchte 2 Männchen aus Aegypten (Alexandrien: Abukir, 1.4.33, leg. G. KOCH und 8 aus Tunis: Sousse, 2 Männchen, 27.4.61 und Zuara, 6 Männchen, 29.4.61, samtlich H. ECKERLEIN leg).

Holotypus (aus Aegypten) in meiner Sammlung, Paratypoid (aus Aegypten) in der Sammlung C. MANCINI, Genua.

Das Weibchen zeigt gegenüber dem Männchen nur geringe Unterschiede. Es ist etwas grösser, 3,5× so lang wie das Pronotum breit und von gleicher Zeichnung und Behaarung wie das Männchen. Der Scheitel ist 1,8× so breit wie das Auge. Auf der Stirnschwiele besteht die schwarze Färbung oft nur aus 2 schwarzen Längsflecken. Im übrigen ist der Kopf wie beim Männchen gezeichnet. Auch die Längenverhältnisse der Fühlerglieder entsprechen völlig denen des Männchen. Erganzend sei aber berichtet, dass das 4. Glied nur 0,73× so lang ist wie das 3. Die Gesamtlänge der Fühler beträgt 1,5 Pronotumbreiten. Die Hinterschiene trägt an der Innenseite in der basalen Hälfte eine Reihe von 5 grossen, schwarzen Punkten.

Länge: Weibchen = 2,9-3,25 mm.

Durch das Auffinden dieser Art in Tunis könnte der Verdacht entstehen, dass sie identisch sei mit dem von dort beschriebenen *Dicyphus sedilloti* Puton (1886). Das ist nicht der Fall. Bei *Dicyphus sedilloti* Put. übertrifft die Gesamtlänge der Fühler kaum die Pronotumbreite, das 3. und 4. Fühlerglied sind gleich lang und über Stirn und Scheitel läuft nur eine braune Längsbinde. Die Gesamtlänge beträgt nur 2,75 mm.

Herr Dr. ECKERLEIN konnte auch die Wirtspflanze der Art ermitteln. *Cyrtopeltis kochi* n. sp. lebt an *Silene succulenta* Forsk.

10 Weibchen aus Tunis: Sousse, 27.4.61; 2 Weibchen und Zuara, 29.4.61, 8 Weibchen, samtlich H. ECKERLEIN leg.

Allotypoid und Paratypoide in meiner Sammlung, Paratypoide auch in der Sammlung H. ECKERLEIN, Coburg.

2.   Eurycolpus dimorphus nov. spec.

Männchen langgestreckt und fast parallelseitig, 4,4× so lang wie
das Pronotum hinten breit ist.   Weibchen kürzer und breiter, etwas
mehr oval und 3,46× so lang wie des Pronotum breit ist.   Gelblich,
teilweise grün.   Behaarung der Oberseite fein, hell goldglänzend, ohne
schwarze Haare.   Männchen makropter ; Weibchen pseudobrachypter.

Kopf (Fig. 2, a + b) von oben gesehen viel breiter als lang, vorn
gerundet.   Scheitel ohne Kante, aber mit 2 undeutlichen Gruben, beim
Männchen 1,1×, beim Weibchen 2,0× so breit wie das gewölbte, grob
gekörnte, braune Auge.   Von vorn gesehen (Fig. 2, c + d) ist der Kopf
deutlich breiter als hoch, der Tylus gegen die Spitze verjüngt und von
der Stirn durch eine deutliche Querfunche getrennt.   Fühlergrube
beim Männchen am inneren Augenrande etwas oberhalb der unteren
Augenecke, beim Weibchen etwas unter derselben gelegen.   Seitlich
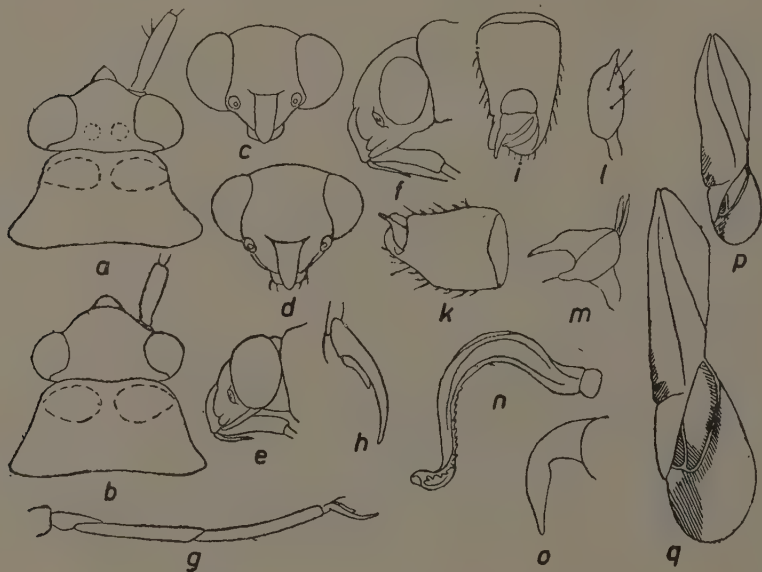
Abb. 2: *Eurycolpus dimorphus* nov. spec.: a = Kopf und Pronotum des
Männchen von oben (31,5×); b = dasselbe vom Weibchen (31,5×); c = Kopf
des Männchen von vorn (31,5×); d = dasselbe vom Weibchen (31,5×); e =
Kopf des Männchen seitlich (31,5×); f = dasselbe vom Weibchen (31,5×);
g = Hinterfuss (67×); h = Klaue des Hinterfusses (168×); i = Genitalsegment
des Männchen von oben (31,5×); k = dasselbe seitlich (31,5×); l = rechter
Genitalgriffel von oben (84×); m = linker Griffel von oben (84×); n = Vesika
des Penis seitlich (84×); o = Spitzenteil der Theka seitlich (84×); p = linke
Halbdecke des Weibchen (16×); q = dasselbe vom Männchen (16×).

gesehen (Fig. 2, e + f) bedeckt das Auge beim Männchen die ganze Kopfseite, der Tylus steht etwas vor, sein unterer Teil ist rückwärts gerichtet. Fühler gelblich, die Spitzenhälfte des 2. Gliedes sowie das 3. und 4. Glied ganz dunkelbraun. 1. Glied schlank, beim Männchen 1,5 × , beim Weibchen 1,05 × so lang wie der Scheitel breit ist, innen mit einigen hellen Borsten ; 2. Glied stabförmig, Bei Männchen und Weibchen gleich dünn, beim Männchen 1,45 × , beim Weibchen 1,1 × so lang wie das Pronotum hinten breit ist. 3. Glied 0,7 × so lang wie das 2. und beim Männchen fast 3 × , beim Weibchen 3,2 × so lang wie das 4.

Pronotum (Fig. 2, a + b) viel breiter als lang, 1,3 × so breit wie der Kopf samt Augen. Vorder- und Seitenrand deutlich eingebuchtet ; auch der Hinterrand leicht geschweift. Schwielen gewölbt, aber undeutlich. Schildgrund unbedeckt. Halbdecken weisslich, durchscheinend. Innenrand des Clavus und Adern des Corium gelblich ; hintere Aussenecke des Corium gelbbraun. Membran milchweiss, ein breiter, graubrauner Streif am Aussenrande ; Adern weisslich, graubraun gesäumt, die kleine Zelle ganz graubraun (Fig. 2, p + q). Beim Männchen ist die Membran voll entwickelt und überragt das Abdomenende weit (Fig. 2, q), beim Weibchen sind die Membran und der Cuneus verkürzt und lassen das letzte Abdominalsegment und die Seiten des Abdomens unbedeckt (Fig. 2, p).

Unterseite hell gelblich oder grünlich. Rostrum mit schwarzer Spitze, die Hinterhüften etwas überragend, das 1. Glied überragt kaum den Hinterrand des Kopfes. Beine lang und schlank, gelbbraun, Schenkel etwas dunkler. Schienen mit feiner heller Behaarung und schwarzen Dornen, die etwas länger sind als die Schiene dick ist, aber ohne schwarze Punkte. Tarsen auffallend schlank (Fig. 2, g). An den Hintertarsen ist das 3. Glied so lang wie das 2. und 2,7 × so lang wie das 1. Klauen (Fig. 2, h) sehr schlank, wenig, aber gleichmässig gekrümmt, an der Basis ein kleiner Höcker. Pseudarolien schmal, die Mitte der Klaue nicht erreichend, die Spitze frei.

Genitalsegment des Männchen von oben gesehen (Fig. 2, i) lang und schlank, seitlich gesehen (Fig. 2, k) unterseits mit leichtem Quereindruck. Genitalöffnung lang und schmal. Rechter Genitalgriffel (Fig. 2, l) blattartig, oval, Hypophysis spitz. Linker Griffel (Fig. 2, m) zangenartig, Hypophysis lang und schlank, spitz und fast gerade. Sinneshöcker mit zungenförmigen Fortsatz, der distal eine Borste trägt. Vesika des Penis (Fig. 2, n) S-förmig gekrümmt, in der distalen Hälfte mit einer Reihe kurzer Zähne am Innenrande, Spitze abgerundet, ohne Chitinstab. Sekundäre Gonopore weit vor der Spitze. Spit-

zenteil der Theka (Fig. 2, o) schlank, im basalen Teil stark gekrümmt, distal fast gerade und gegen die Spitze verjüngt.

Länge : Männchen = 4,33 mm. ; Weibchen = 3,30-3,35 mm.

E. dimorphus nov. spec. muss wegen der Form der Klauen und ihrer Anhänge, sowie wegen der eingebuchteten Pronotumseiten in die Gattung *Eurycolpus* Reut. gestellt werden. Auch die Form der Vesika des Penis spricht dafür, obgleich der Spitze der schlanke Chitinstab der beiden anderen Arten fehlt. Die Art unterscheidet sich von *E. flaveolus* Stael und *E. enslini* Seid. durch weit längeres Rostrum, grösseres Auge, die verkürzten Halbdecken beim Weibchen und hellere Färbung. *E. enslini* Seid. ist überdies von kleinerer Gestalt und *E. flaveolus* Stael trägt eine kräftige, schwarze Behaarung. *E. parallelus* (*Omocoris parallelus* Lindbg.) hat ebenfalls ein längeres Rostrum, ist aber 6,5 mm. lang, hat schwarze Behaarung, viel kürzere Fühler, aber längere Hinterschienen und einen hinten schwach gerandeten Scheitel.

Ich untersuchte 1 Männchen und 2 Weibchen aus Aegypten : Mersa Matrouh 20.3.33, leg. H. Priesner.

Holotypus und Paratypoid in meiner Sammlung, Allotypoid in der Sammlung H. Priesner, Linz.

3. Campylomma verticata nov. spec.

Von länglich ovaler Gestalt, das Männchen 2,7-3,0× so lang wie das Pronotum hinten breit ist. Hell graugelblich, mit nur geringer schwarzer Zeichnung. Oberseite mit feinen, braunen Haaren bedeckt, die vor allem im Cuneus deutlich sind. Schildgrund orangegelb.

Kopf sehr kurz, stark geneigt, von oben gesehen (Fig. 3, a) etwa 3× so breit wie lang. Scheitel und Stirn flach, kaum gewölbt ; ersterer beim Männchen etwa so breit wie das runde, stark gewölbte, grob gekörnte, graurote Auge. Von vorn gesehen (Fig. 3, b) ist der Kopf 1,5× so breit wie hoch. Stirn mit einem Kranz kleiner schwarzer Flecke. Dieser Kranz ist zwar bei beiden vorliegenden Männchen vorhanden, es ist jedoch zweifelhaft, ob er ein spezifisches Merkmal ist. Hinterrand des Scheitels scharfkantig. Seitlich gesehen (Fig. 3, c) verdeckt das Auge fast den ganzen Kopf, nur die kurze Kopfspitze ist sichtbar. Fühlergrube am inneren Augenrande neben der unteren Augenecke gelegen. Fühler (Fig. 3, d) hell bräunlich, mit sehr feinen, kurzen Härchen bedeckt ; das 1. Glied mit Ausnahme von Grund und Spitze, sowie ein breiter Ring nahe der Basis des 2. schwarz. 1. Glied

0,75× so lang wie der Scheitel breit ist ; 2. Glied so dick wie das 1. und 3,2× so lang wie dieses, aber nur 0,86× so lang wie der Kopf samt Augen breit ist ; 3. Glied kaum halb so dick wie das 2. und nur 0,6× so lang ; 4. Glied 0,63× so lang das 3., gegen die Spitze verjüngt.

Pronotum (Fig. 3, a) sehr kurz und breit, mit fast geraden Seiten und gerundetem Hinterrand. Schwielen undeutlich, hinter ihnen in der Mitte eine kleine Grube. Scutellum mit zum Teil freiem Basalteil. Halbdecken völlig ungezeichnet. Membran hell rauchgrau, Adern grau.

Unterseite hell gefärbt. Das Rostrum reich zwischen die Hinterhüften. Beine weissgelblich, Schenkel mit einzelnen schwarzen Flecken. Schienen mit schwarzen Dornen, die aus schwarzen Punkten entspringen, die an der Basis der Schienen gross sind, gegen die Spitze kleiner werden und im Spitzenteil der Hinterschienen, sowie an den Vorder- und Mittelschienen oft fehlen. An den Hintertarsen (Fig. 3, e) sind das 2. und 3. Glied gleich lang und jedes von ihnen mehr als 2× so lang wie das 1. Klauen (Fig. 3, f) mässig gekrümmt, verhältnismässig schlank. Pseudarolien schmal, die Klauenmitte nicht erreichend.

Genitalsegment des Männchen (Fig. 3, g) kurz und breit, mit langer Behaarung. Rechter Genitalgriffel (Fig. 3, h) sehr klein, gegen die Spitze verbreitert, mit kleiner, stumpfer Hypophysis. Linker Griffel (Fig. 3, i + k) zangenförmig, Hypophysis lang, dünn und fast gerade. Sinneshöcker flach, fast blattartig, mit grossem, spitzem Zahn. Vesika des Penis (Fig. 3, l) S-förmig gewunden, sehr schlank, sekundäre Gonopore weit vor der Spitze. Spitzenteil (Fig. 3, m) gekrümmt, mit 3 ungleichen Chitinspitzen. Spitzenteil der Theka (Fig. 3, n) sehr schlank, proximal stark gekrümmt, distal gerade und gegen die Spitze verjüngt.

Länge : Männchen = 2,25-2,50 mm. ; Weibchen unbekannt.

C. verticata n. sp. unterscheidet sich von den übrigen Arten der Gattung durch den flachen, schmalen Scheitel und das ungewöhnlich grosse Auge. *C. minima* E. Wagn. hat zwar gleichfalls einen schmalen Scheitel, ist aber wesentlich kleiner, hat völlig ungefleckte Fühler, deren 2. Glied kürzer ist, ein kürzeres Rostrum, dickere Klauen und anders gebaute Genitalien des Männchen, vor allem hat die Vesika distal nur 2 Spitzen. Bei *C. impicta* E. Wagn. ist die Vesika ebenfalls 3 spitzig, aber die Art hat einen viel breiteren Scheitel, kleineres Auge, ungefleckte Schenkel und die Vesika des Penis hat eine ganz andere Gestalt. Auffällig ist auch die eigenartige Zeichnung der Stirn, die

noch bei keiner anderen Art angetroffen wurde, der aber kein Gewicht
beigelegt wird.
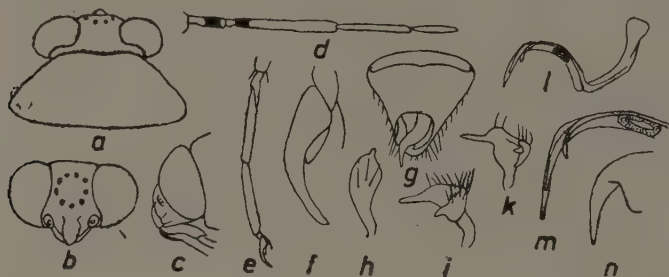
Abb. 3: *Campylomma verticata* nov. spec. (Männchen): a = Kopf und
Pronotum von oben (31,5×); b = Kopf von vorn (31,5×); c = Kopf seitlich
(31,5×); d = Fühler (31,5×); e = Hinterfuss (47,5×); f = Klaue desselben
(190×); g = Genitalsegment von oben (31,5×); h = rechter Genitalgriffel von
oben (168×); i = linker Griffel von oben (84×); k = derselbe von innen (84×);
l = Vesika des Penis seitlich (84×); m = Spitze derselben (168×); n = Spit-
zenteil der Theka seitlich (84×).

Ich untersuchte 2 Männchen aus Aegypten: Küste des Roten
Meeres, 20.1.33, leg. H. Priesner.

Holotypus in meiner Sammlung, Paratypoid in der Sammlung
H. Priesner, Linz.

Am Schluss möchte ich noch einmal meinen besten Dank ausspre-
chen für Zuleitung des Materials an Herrn Prof. Dr. H. Priesner, Linz,
und Herrn Cesare Mancini, Genua.

LITERATUR

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Complex (*Ann. Mag. Nat. Hist.*, Ser. 12, V, pp. 158-166).

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Seidenstucker, G. (1959): *Eurycolpus enslini* nov. spec. (*Mitt. Deut-
sche Ent. Gesel.*, XVIII (5), pp. 74-76).

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Ent. Egypte*, XLIV, pp. 93-96).

SUPPLEMENT TO
«A REVIEW OF THE HEMIPTERA HETEROPTERA KNOWN TO US FROM EGYPT»

(with 1 Text-Figure)

by Prof. Dr. H. PRIESNER (Linz, Austria)
and E. WAGNER (Hamburg).

The following list represents an additional to the paper of H. Priesner and A. Alfieri, bearing the above title (*Bull. Soc. Fouad I Entom.*, XXXVII, 1953, pp. 1-119).

It contains all those additions to the fauna that have become known to us, but also corrections of taxonomic or nomenclatorial nature. The records were obtained from the following sources :

(1) A number of species that were sent for identification by Mr. A. Mancini (Genoa) to E. Wagner, and which were mainly collected by C. Koch and W. Wittmer during their stay in Egypt.

(2) Captures made by H. Priesner, forming the major part of the supplement, completed by such of other collectors from whom he had received them.

(3) A number of species reported as Egyptian by R. Linnavuori in his paper "Palaearctic Heteropterous material collected by J. Sahlberg and U. Saalas" (*Ann. Ent. Fenn.*, XIX (4), 1953, pp. 148-156). These species could not be re-examined.

Besides, the Literature Index is being supplemented by those papers on Egyptian Heteroptera, which have appeared thus far.

Since the original paper (by Priesner and Alfieri) had been built up in the shape of a key we thought it advisable to indicate the page of insertion to each supplement, and also to add the main characters

by which the newly recorded species can be distinguished from the originally listed ones. By this we trust to enable the reader to identify those species, too. One would be mistaken, however, if one intended to identify by means of these notes, species of territories other than Egypt, as these diagnostic characters separate the species in question only from the other Egyptian species.

In order to avoid discussions of a zoogeographical nature the distribution of each species is given.

All species recorded were identified by E. WAGNER, with the exception of those reported by LINNAVUORI.

We should not like to miss the occasion to express our sincere thanks to all those entomologists who aided us in the completion of this paper, namely : Mr. A. MANCINI (Genoa), Mr. G. SEIDENSTUECKER (Eichstätt) and Mr. A. ALFIERI (Cairo).

CHANGE OF GENERIC NAMES

For reasons of priority the following names have to be changed :
Cydnus F. (pp. 7 and 8) to *Aethus* Dall.
Brachypelta Am. et Serv. (pp. 6 and 8) to *Cydnus* F.
Pseudophloeus Burm. (pp. 30 and 33) to *Arenocoris* Hahn.
Stenocephalus Latr. (pp. 31 and 34) to *Dicranocephalus* Hahn.
Therapha Am. et Serv. (pp. 31 and 36) to *Corizus* Stål.
Nysiodes Dist. (pp. 40 and 43) to *Camptocoris* Jak.
Raglius Stål (pp. 54 and 58) to *Rhyparochromus* Hahn.
Rhyparochromus Curt. (pp. 55 and 56) to *Megalonotus* Fieb.
Lachnophorus Reut. (pp. 54 and 58) to *Lachnestes* Bergr.
Monanthia Lep. et Serv. (pp. 63 and 65) to *Dictyla* Stål.
Microphysa Westw. (p. 84) to *Loricula* Curt.
Lopus Hahn (p. 93) to *Capsodes* Dhlb.
Restheniini Reut. (p. 85) to *Capsodini* E. Wgn.

1. Family CYDNIDAE Billbg.

Aethus flavicornis longispinis E. Wagner (p. 8).

Mex, 17.8.36, leg. H. PRIESNER.

REUTER'S (1899) and ROYER'S (1914) records of *A. flavicornis* F. refer probably to this subspecies. It is distinguished from *A. flavicornis flavicornis* F. by its larger size, shorter head, much longer spines at the cephalic margin, narrower vertex and larger eye. It was

hitherto reported from South Russia, Caucasia, Transcaspia, Afghanistan and Iran.

Aethus syriacus Horvath (p. 8).

Mex, 22.7.36, leg. H. PRIESNER.

Contrary to *A. flavicornis* F. and *A. pilosulus* Klug this species bears two spines at the apex of the tylus. It occurs in Syria and Palestine, as well as in the whole North Africa to the Cape Verde Islands.

Geotomus intrusus E. Wagner (p. 9).

1953 recorded already as "spec. nov.". The species, described from Egyptian material (E. WAGNER, 1953), differs from the remaining species of the genus by the lack of opaque areas on meso- and metasternum. It was also found in Algeria.

Ochetostethus sahlbergi E. Wagner (p. 9).

Also this species was described from specimens from Egypt and Palestine. It is distinguished from *O. nanus* H.S. by larger eyes, narrower vertex and longer scutellum. *O. nanus* does not exist in Egypt. This name has, therefore, to be replaced on pages 9 and 10 by *sahlbergi* E. Wgn. The species is distributed through the whole of North Africa and Spain to South France.

3. Family PENTATOMIDAE Leach ([1])

Odontoscelis seminitens E. Wagner (p. 14).

Helouan, 24.9.32 and 4.10.32, leg. H. PRIESNER.

It is distinguished from *O. dorsalis* F. by the shine of the surface, the broader scutellum and the slenderer antennae. *O. dorsalis* F. does most likely not occur in Egypt. *O. seminitens* Wgn. was described from Cyprus, but later also found in Syria.

Dyroderes umbraculatus (F.) (pages 12 and 23).

Mokattam hills, 29.1.04, leg. J. SAHLBERG (cf. LINNAVUORI).

The genus *Dyroderes* Spin. differs from *Sciocoris* Fall. by a small process at the collar angle of the pronotum, and by the fact that the head is narrower than the base of the scutellum. *D. umbraculatus* is distributed through the whole Mediterranean area and eastward to Caucasia.

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(1) The numbering of the families corresponds with that given in PRIESNER and ALFIERI (1953); some numbers are thus missing in the present paper.

Carpocoris mediterraneus Tamanini (p. 23).

A check of the Egyptian material, as far as it was accessible, revealed that all specimens hitherto referred to *C. fuscispinus* Boh. belonged to the above species. *C. fuscispinus* Boh. does not occur in Egypt. This name has to be replaced (p. 23) by *C. mediterraneus* Tam. The species occurs all over the Mediterranean.

Anchesmus rubriplaga (Walker) (p. 29).

The species *A. ruficornis* Stål is, according to SEIDENSTUECKER (1957), identical with *Khondana rubriplaga* Walk., and has, therefore, to bear the above name.

4. Family COREIDAE Leach

Microtelocerus testaceus Reut. (p. 30).

Wadi El-Lega, Sinai, 6.9.41, leg. H.C. EFFLATOUN (Coll. Cairo Univ.).

The genus, belonging to the *Pseudophloeinae* Stål, is distinguished from all other genera by the unusually short fourth antennal joint. It was hitherto found in Turkestan and Iran.

Arenocoris intermedius (Jak.) = Pseudophloeus angustus Reut. (p. 34).

These two species are identical. On page 34 has, therefore, the first name to be inserted. The species was also recorded by LINNAVUORI (1953) : Cairo, 13.1.04, leg. U. SAALAS.

Distributed through the whole Mediterranean, eastward to Turkestan and Iran.

6. Family LYGAEIDAE Schill. (= Myodochidae Kirk.)

Nysius aegyptiacus Priesner and Alfieri (p. 43).

This form is a proper species, as E. WAGNER (1959) proofs. The name has to be changed accordingly, on page 43. Up to the present found in Egypt only.

Piocoris aurantiacus Bergevin (p. 46).

Fayoum, 8.1.04, leg. U. SAALAS ; Heliopolis, 21.1.04, leg. J. SAHLBERG. On *Acacia* blossoms (LINNAVUORI).

The species comes closest to *P. luridus* Fieb., but is of shorter build, and has much larger eyes that bear a smooth whitish callosity.

Described from the Sahara.

Artheneis foveolata Spinola (p. 50).

Fayoum, 8.2.04, leg. U. SAALAS (LINNAVUORI, 1953).

We consider this to be a misidentification. *A foveolata* Spin. does not likely occur in Egypt. It is probably *A. alutacea* Fieb. or *A. aegyptiaca* Lindbg.

Marmottania priesneri E. Wagner (p. 56).

South Sinai : Wadi El-Lega, 13.7.43, leg. H. EFFLATOUN and M. SHA-FIK ; Karm Alam, Wadi Isla, 12.4.40, leg. M. TEWFIK.

Hitherto only from Egypt. The species is distinguished from *M. simonis* Put. by the yellow-brown coloration of the pronotum, the rounded posterior angles of the latter and the uniformly smoky brown membrane.

Plinthisus humilis Horvath (p. 57).

Sinai, 16.5.34, leg. H. PRIESNER.

Only the brachypterous form is present. In this the hemi-elytra do not show any membrane-rudiment, and leave uncovered the last two and part of the preceeding segment. Hitherto known from Syria and Palestine.

Stygnocoris breviceps E. Wagner (p. 57).

Mersa Matrouh, 28.3.35, leg. H. PRIESNER ; Dekhela, 8.4.55, leg. ALI HAFEZ (Ain Shams University).

The species was in 1953 recorded as *"Stygnocoris* spec.". The name has to be inserted. Known from the Balkan Peninsula, Sicily, Cyprus and from North Africa.

Lachnestes singalensis (Dohrn) (p. 58).

1953 recorded as *Lachnophorus* spec. A re-examination revealed that it is the above species. It inhabits Africa, Madagascar, South India and Ceylon.

Megalonotus praetextatus (H.S.) (p. 56) subsp. nov.

The Egyptian specimens of this species belong to a subspecies that could hitherto not yet be described. It is characterized by the pale legs and seems to inhabit deserts.

Peritrechus ambiguus Horváth (p. 57).

Cairo, 13.1.04, leg. J. SAHLBERG (LINNAVUORI).

Up to the present the species is reported from South Europe, and is similar to *P. nubilus* Fall., but differs by its smaller size, more parallel-sided shape and anteriorly scarcely narrowed pronotum, from

P. meridionalis Put. it is distinguished by the black coloration of the antennae and femora, and smaller size.

Dieuches schmitzi Reuter (p. 58).

Meadi, 8.6. and 13.6.33, from the detritus of an irrigation canal ; 13.6.34, at the lamp ; all collected by H. PRIESNER.

The species, describeed from Madeira, occurs in the whole North Africa and Arabia, reaching to Iran. It is distinguished from *D. syriacus* Dohrn by the partly yellow lateral margin of the pronotum, from *D. mucronatus* Stäl by the black tips of the femora, and from *D. armipes* F. by smaller size and shorter antennae.

Emblethis minutus Kiritschenko (p. 59).

Meadi, 6.7.37, in the garden ; 13.6.33, under detritus ; Pyramids of Gizah, 15.10.33, under *Panicum,* all collected by H. PRIESNER.

In this species, the first joint of the hind tarsi is scarcely twice as long as the second and third combined. It comes closest to *E. griseus* (Wolff), but is much smaller, and has slightly sinuated sides of the pronotum. It was described from Turkestan, and also found in Transcaspia.

Emblethis bullatus Fieber (p. 60).

The species has to be cancelled, as it is only an unsignificant variety of *griseus* Wolff.

Gonianotus barbarus Montandon (p. 60).

Cairo, i.39, 1 female, leg. H. PRIESNER.

The occurrence of this species was questioned by PRIESNER and ALFIERI (1953). By the above specimen the existence in Egypt is proved. The species inhabits the Canary Islands and North Africa.

Camptocera glaberrima Walker var. angustula Puton (p. 61).

The forms *C. horvathi* Jak., *C. angustula* Put. and *C. glaberrima* Walk. belong to the same species which has to be called *glaberrima* Walk. The Egyptian specimens seem to belong to var. *angustula* Put., and this could be proved in some specimens. Distributed through the whole of North Africa, Iran and Turkestan.

9. Family TINGIDAE Costa

Cysteochila zavattariae Mancini (p. 65).

Sinai, Wadi Ferran, 28.5.35, leg. H. PRIESNER (coll. Min. Agric., Cairo).

The genus is near *Physatocheila* Fieb., but differs by the blister-like enlarged posterior part of the lateral margin of the pronotum, and by its slenderer shape. The species is known from the Sahara and the Sudan.

Dictyla platyoma (Fieber) (p. 65).

Salloum, 3.33, leg. H. PRIESNER.

The species differs from the other species of the genus by the lateral margin of the pronotum, the reflexed part of which is touching the median carina anteriorly. It is widely distributed in the Mediterranean, and occurs to Siberia, but has not yet been reported from North Africa.

Monostira minutula (Montandon) (p. 66).

Abu Simbil, 4.4.31, leg. H. PRIESNER.

In 1953 this species was erroneously announced from the Oasis Kharga. However, the following species was meant. The true *M. minutula* is now known from the above locality. It also occurs in Tunisia and Iran.

Monostira priesneri E. Wagner (p. 66).

Kharga Oasis, 17.4.29, leg. H. PRIESNER, on *Zizyphus*.

In 1953 noted as *Monostira* spec. From Egypt only.

11. Family REDUVIIDAE Latr.

Empicoris mediterraneus Hoberlandt (p. 69).

Wadi Digla, November, leg. H. PRIESNER.

The species was originally described from Turkey and comes close to *E. culiciformis* Deg.

Reduvius minutus Reuter (p. 75).

Meadi, 6.8.35, leg. H. PRIESNER.

The opinion of 1953 that it might be an unknown species could not be upheld. On page 75, instead of "spec. nov.", *minutus* Reut. has to be inserted.

Reduvius dorsalis Stål (p. 75).

Mariout, 23.8.34, leg. A. RABINOVITCH.

This species is not, as was thought originally, identical with *R. tabidus* Klug. It only occurs in Egypt, Palestine and Nubia.

Paramphibolus alfierii E. Wagner (p. 76).

Wadi Umm-Assad, 14.10.34, leg. A. ALFIERI.

Two males, the authentic material. The species differs from *P. pusillus* Reut. by the smaller size and the antennae, the third joint being shorter than the second or the fourth. From Egypt only.

12. Family NABIDAE Costa

Nabis capsiformis Germar (p. 80).

Common all over the country, on grasses and other weeds, all the year.

By an error, the above note was omitted 1953, and should be added on page 80.

13. Family HEBRIDAE Fieb. (Naeogeidae Kirk.)

Naeogeus jeanelli Poisson (p. 80).

Sinai, Wadi Gederat, leg. H. PRIESNER.

The species is distinguished from the two other species recorded from Egypt by its smaller size, the reddish-brown colour and more strongly bent hind femora and tibiae. Aethiopian species.

15. Family CIMICIDAE Latr.

Cimex columbarius Jenyns ? (p. 81).

Kerdasa, 2.30, in a bird's nest, leg. H. PRIESNER.

The identification is not certain, but most probably it is the above species which is very close to *C. lectularius* L., and is by some authors considered to be an ecological race of it. It is distinguished from *C. lectularius* L. by the second antennal joint which is as long as the third, while it is shorter in *lectularius*. Hitherto from Europe only.

17. Family ANTHOCORIDAE Am. et Serv.

Anthocoris gallarum-ulmi (Degeer) (p. 82).

Piovera, Alexandria, X.56, leg. DORIA (in coll. MANCINI).

The occurrence of this species was doubted in 1953 ; now it is proved by this new record.

Anthocoris pemphigi E. Wagner (p. 82).

Mansura, 10.7.54, in galls of *Pemphigus napaeus,* leg. S. H. MAHROUS.

This species is allied to the well-known *A. némoralis* F., but is considerably smaller, has much coarser, erect pilosity, and has much shorter antennae, with joint 3 only 0.45 times as long as joint 2. From *A. gallarum-ulmi* it also differs by the stronger pilosity and the smaller size. Hitherto from Egypt only.

Orius laevigatus inaequalis E. Wagner (p. 82).

Wadi El-Tih, 20-24.2.39 ; Suez Road, 1.3.36 ; Montaza, 1.3.39 ; Mersa Matrouh, all collected by H. PRIESNER ; El-Kantara, 9.7.94, leg. GULDE ; Egypt (coll. SIGNORET).

This subspecies is somewhat smaller than the nominal race and has two unequal points at the flagellum of the phallus. Only known from North Africa (Algeria and Egypt).

Orius niger aegyptiacus E. Wagner (p. 82).

Heliopolis and Helouan, leg. U. SAALAS ; Upper Egypt (in coll. Mus. Helsinki).

This subspecies differs from *O. niger niger* Wolff by smaller size, long, dense, pale pilosity, remarkably short, broad shape, as a rule brown coloured pronotum and in the male by proximally pale middle tibiae. Only from Egypt.

Xylocoris heluanensis E. Wagner (p. 83).

Helouan, 2.3.33, leg. C. KOCH ; 10.6.33, leg. W. WITTMER (in coll. MANCINI).

Closely allied to *X. obliquus* Costa, but smaller and paler, with evenly curved discharging sulcus of the olfactory glands, which terminates far from the fore margin of the metasternum. By the latter character it is easily separated from the remaining species, too. Only from Egypt.

Cardiastethus fasciiventris (Garbiglietti) (p. 84).

Wadi Hof, 11.3.36, leg. H. PRIESNER.

Larger and paler coloured than *G. nazarenus* Reut. Mediterranean species known from conifers.

19. Family TERMATOPHYLIDAE Reut.

Argyrotelaenus simoni Reuter et Poppius (p. 85).

Esbet-el-Nakhl, 1.8.38, leg. W. WITTMER.

Differs from *A. elegans* Reut. by its slenderer, longer head, shorter antennae and exteriorly crescent-like widened spot on the corium. Hitherto only from Arabia.

20. Family MIRIDAE Hahn.

Cranocapsus puncticeps E. Wagner (p. 93).

El-Wasta, leg. REIMOSER.

The genus looks superficially like *Camptobrochis* Fieb., but differs from it by the foveolae on the frons, longer head and by the short, thick antennae. The species was described from Egypt, but was recently recorded from the Lake Tchad.

Creontiades caucasicus Poppius (p. 90).

Meadi, 23.4.39, leg. H. PRIESNER.

The species is distinguished from *C. pallidus* Ramb. in having fine, short, black hairs at the margins of the hemielytra, and on the 1st antennal joint; the latter is much shorter than the width of the head. In *C. pallidus* the 1st antennal joint is as long as the width of the head, and black hairs are entirely wanting. The species was described from Caucasia, but was recently found in Palestine and Arabia, too.

Cyphodema berkanense E. Wagner (p. 92).

Sinai, Wadi Luotaie, 5.5.35, leg. W. WITTMER (in coll. MANCINI).

Near to *C. oberthuri* Put., but distinguished by the longitudinal direction of all black spots on the pronotum and the hemielytra. The genus *Cyphodema* has to be placed near *Lygus,* but differs from this genus by the long, strongly engaged hind femora. Hitherto only from North Africa.

Trigonotylus pallidicornis Reut. (p. 93).

In 1953, E. WAGNER has proved that *T. pallidicornis* Reut. and *T. breviceps* Jak. are two well separable species. All Egyptian records belong to *T. pallidicornis* Reut. The name *brevipes* Jak. (page 94) has therefore to be altered to *pallidicornis* Reut.

Cyrtopeltis (Nesidiocoris) tenuis (Reuter) (p. 94).

The species *Engytatus tenuis* has now to bear the above name. CARVALHO and CHINA (1952) have proved that it belongs to the subgenus *Nesidiocoris* Kirk.

Cyrtopeltis (Cyrtopeltis) pygmaea E. Wagner (p. 94).

Abusir Pyramids (Sakkara Road), 8.1.55 ; Wadi Ferran, Sinai, 14.5.34 ; St. Katharin Monastery, 16.5.34. — On *Trichodesma africanum,* all collected by H. PRIESNER.

The subgenus *Cyrtopeltis* is distinguished from *Nesidiocoris* by the lack of the process at the lower margin of the genital opening of the male. *C. pygmaea* E. Wagn. is, besides, considerably smaller than *C. tenuis* Reut., being only 1.85-2.05 mm. long. From Egypt only.

Cyrtopeltis (Cyrtopeltis) kochi E. Wagner (p. 94).

Alexandria (Abukir), 1.4.33, leg. C. KOCH (in coll. MANCINI).

Differing from the remaining species of the genus by black pilosity, thick antennae and well pronounced pronotal callosities. From Egypt only.

Laemocoris reuteri Jakovlev (p. 95).

Dekheila, 7.7.33, leg. C. KOCH.

Allied to *L. costai,* but differing from it in that the anterior white transverse band of the elytra goes over the clavus, and that the coloration of the hemielytra is ferruginous. Known from Morocco, Algeria, Transcaspia and Turkestan.

Sytsellonotus thymi Signoret (p. 95).

Assiout, 30.1.33, leg. C. KOCH (in coll. MANCINI).

S. putoni Reut. is identical with this species. This name has to be changed to *thymi* Sign., on page 95. Widely distributed in the Mediterranean.

Orthotylus (Melanotrichus) haloxyloni E. Wagner (p. 96).

Wadi Digla, 26.9.33 and Wadi El-Tih, 3.11.33, all on *Haloxylon schweinfurthi,* and collected by H. PRIESNER.

. Allied to *minutus* Jak., but larger, and has pale veins of the membrane and a shorter rostrum that reaches only to the middle coxae. It was recently also found in Palestine.

Orthotylus (Melanotrichus) pusillus Reuter (p. 96).

Wadi Digla, 26.9.33 ; Meadi, 30.4.33 and 6.5.31, at the lamp ; all collected by H. PRIESNER.

It is one of the smallest species of the genus, differing from *minutus* Jak. by the long rostrum which distinctly surpasses the hind coxae, by longer antennae, deep green veins of the membrane and by the structure of the genitalia of the male (description by E. WAGNER, 1956). Hitherto known from Turkestan.

Eurycolpus dimorphus E. Wagner (p. 89).

Mersa Matrouh, 20.3.33, leg. H. PRIESNER.

The genus *Eurycolpus* has to be placed near *Conostethus* Fieb. and *Stenoparia* Fieb., and is distinguished from the former in that the third tarsal joint is not longer than the second, and that the tibiae bear conspicuous black spines ; from the latter in that the sides of the pronotum are distinctly concave. The species attracts notice in having abbreviated hemielytra in the female. Hitherto only from Egypt.

Malthacosoma halimocnemis (Becker) (p. 97).

The species was erroneously described as new (from Egypt) under the name of *Solenoxyphus barbatus* E. Wagn. The latter name (p. 97) has therefore to be altered to *Malthacosoma halimocnemis* Beck. The Egyptian specimens belong to the var. *impunctata* E. Wagner. The species is distributed from Egypt through Iran to South Russia and Turkestan.

Psallus (Coniortodes) scutellaris Reuter (p. 97).

Wadi Assiouti, 1.1.32, leg. H. PRIESNER.

The species belongs to the subgenus *Coniortodes* E. Wagn., in which the hemielytra are covered with small, dark dots. It differs from *P. adspersus* K. Schm. by its smaller size, and by the black colouration of the first antennal joint, the head, the anterior part of the pronotum and the femora. The insect belongs to the var. *balachowskyi* E. Wagn., in which the hemielytra are whitish. The species is widely distributed in the desertic regions of North Africa.

Atomoscelis tomentosus Reuter (p. 98).

Sakkara, 12.4.57, on *Heliotropium luteum* Poir., leg. H. PRIESNER.

Up to the present taken only by SAHLBERG (p. 98). PRIESNER succeeded in finding the host plant and WAGNER (1958) was able to describe the male which was unknown thus far.

Anonychiella fokkeri (Reuter) (p. 98).

Fayoum, 20.4.35, leg. A. MOCHI.

Of this species no exact locality was hitherto known. It is recorded from various localities of the deserts of North Africa.

Campylomma impicta E. Wagner (p. 98).

Heliopolis, 7.7.29 ; Meadi, 7.6.31, 13.6.34, 27.3.35 and 26.5.36, all collected by H. PRIESNER, at the lamp.

An obviously common species, but up till now confused with *C. nicolasi* Reut., differing from this species by the spotless antennae, the uniformly pale head, the longer rostrum that almost reaches the apex of the hind coxae, by shorter antennae and the structure of the genitalia of the male. Recently also found in Arabia.

Campylomma verticata E. Wagner (p. 98).

Red Sea Coast, 20.1.33, leg. H. PRIESNER.

Similar to the former species, but the vertex of the male only as broad as the eye. Antennae and frons with black markings. Differing from *C. zizyphi* Reut. by the black first antennal joint and the immaculate hemielytra, as well as by the large eye. So far only from Egypt.

Maurodactylus nigrigenis Reuter (p. 99).

Wadi Digla, 20.3.39, leg. H. PRIESNER.

The genus is distinguished from the remaining genera by the remarkably long slender claws on which the arolia are very fine and long, reaching the middle of the claws. The exceedingly short head shows black markings anteriorly. The species was taken already in Arabia and North Africa.

Auchenocrepis alboscutellata Puton (p. 99).

Listed as *A. minutissima* Rmb. f. *alboscutellata*, in 1953. How-
ever, it is a proper species, and thus the name must be changed to
alboscutellata Put. *A. minutissima* Rmb. does not occur in Egypt.

Tuponia tamaricis (Perris) (p. 100).

Has to be cancelled. All records pertain to *T. lethierryi* Reut.

27a. Family GELASTOCORIDAE Kirk.

Scylaecus rugosus Desj. (p. 105).

Red Sea Coast, leg. W. KUEHNELT.

This is the first representative of the subfamily *Mononychinae*
Fieb. of the *Gelastocoridae* or frog bugs (see key page 61).

The family has to be inserted after the *Ochteridae*. Ethiopian
species.

32. Family CORIXIDAE Leach

Sigara (Tropocorixa) brevixipha Brown (p. 110).

Bir Abrag, February 38, leg. H. PRIESNER.

Among the Egyptian species the above comes closest to *lateralis*
Leach. However, in *S. brevixipha* Brown the frontal fossa of the male
is much shallower and the hind tarsus is yellowish beneath. So far
only from Arabia.

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ADDENDUM

A MACROPTERUS FEMALE OF
Microvelia priesneri Hoberlandt 1951

In his description of the above species (*Bull. Soc. Fouad I Ent.*, XXXV, 1951, pp. 271-274) HOBERLANDT had only apterous specimens at his disposal. As we have now a macropterous female at hand, it may be described here as an addition to HOBERLANDT's paper.

Slender, 2.4 times as long as the width of the pronotum (Fig. 1). Black-brown to red-brown, with fine, pale pubescence. Legs remarkably long.

Head broader than long, rounded in front. Vertex 3 times as broad as the dark, granulated eye, at the interior margins of the eye

there are longer, white hairs. Antennae testaceous, pubescent, the tips of the segments 1-3 slightly darkened, joint 4 wholly dark ; joint 2 1.2 times as long as joint 1 ; joint 4 1.8 times as long as joint 1 and

FIG. 1: *Microvelia priesneri* Hoberlandt (E. WAGNER del.).

1.2 times as long as joint 3.   Pronotum about as long as broad, almost pentagonal, with fine, nearly percurrent longitudinal carina, at the fore margin with two transverse, testaceous spots, and behind them with an indistinct transverse line, in which are placed some long, curved, silvery hairs.   Lateral angles well prominent, almost pointed. Anterior lateral margin scarcely concave, posterior lateral margin slightly arched, apex rounded.   Hemielytra dull grey-white, with dark markings in its posterior portion, the veins blackish-brown.   Exterior margin long pilose in its basal part.   Dorsum and underside as in the apterous form.   Legs even longer and slenderer than in this form. Hind tibia, length 0.79 mm., i.e. 34% of the length of the body.

Body length 2.3 mm.   Width of head 0.50 mm.   Width of pronotum 0.96 mm.   Lengths of antennal joints : joint 1 : 0.16, joint 2 : 0.19, joint 3 : 0.24, joint 4 : 0.29 mm.

The macropterous female differs from the apterous female firstly by the shape of the pronotum, the lateral angles of which are strongly protruding and almost pointed. Besides, the pronotum is darker. In the colouration it is very similar to *M. pygmaea* Duf. In the latter species, however, the macropterous female is considerably smaller (1.8-2.0 mm. long) and has more vividly coloured hemielytra (whitish with almost black veins), a distinctly shorter second antennal joint which is only 0.9 times as long as the first ; joint 4, too, is somewhat shorter. The lengths of the antennal joints are in *pygmaea,* as follows : joint 1 : 0.16, joint 2 : 0.14, joint 3 : 0.18, joint 4 : 0.27 mm. The vertex is 2.5-2.6 times as broad as the eye.

One female (Hypotypoid) from Egypt : Abu Rowash, 17.9.09, leg. G. FERRANTE (coll. ALFIERI).

THE BEHAVIOUR OF THE STABLE FLY LARVA,
Stomoxys calcitrans L.,
TOWARDS SOME ENVIRONMENTAL FACTORS

(with 15 Text-Figures)

by MAHMOUD HAFEZ, M.Sc., Ph.D., F.R.E.S.,

and FAROUK M. GAMAL-EDDIN, M.Sc.

Department of Entomology, Faculty of Science, Cairo University.

CONTENTS

I. INTRODUCTION

For a better understanding of the ecology of *Stomoxys calcitrans* and the behaviour of the larva in its natural micro-climate, series of experiments were undertaken in the laboratory, in which the reactions of the larva, at both the feeding and the prepupating stages to such environmental factors, as humidity, temperature and smell were studied. The results obtained are included in the present paper, which is the fourth in the series of studies on *Stomoxys* in Egypt.

II. REACTIONS TO HUMIDITY

Reactions to air humidity have been experimentally studied in a number of insects, e.g. *Locusta* (KENNEDY, 1937), *Blatta* (GUNN and COSWAY, 1938), *Culex* (THOMSON, 1938), *Tenebrio* (PIELOU and GUNN, 1940), *Pediculus* (WIGGLESWORTH, 1941), Wireworms (LEES, 1943),

Ptinus (BENTLEY, 1944), adult *Musca domestica* (DAKSHINAMURTY, 1948), *Musca domestica* larvae, feeding and prepupating stages (HAFEZ, 1950 and 1953), *Tribolium* (WILLIS and ROTH, 1950), some species of tsetse flies (PERTTUNEN, 1950), certain Carabid beetles (PERTTUNEN, 1951), *Aedes aegypti* and *Blattella germanica* (ROTH and WILLIS, 1952), *Schistocerca* (AZIZ, 1957), *Musca sorbens* larvae, feeding and prepupating stages (HAFEZ and ATTIA, 1958), *Adesmia bicarinata* (HAFEZ and MAKKY, 1960).

The apparatus and methods used for demonstrating the humidity reactions of the larva were substantially the same as those described by HAFEZ (1950 and 1953). On the roof of the warm tank (described by WIGGLEWORTH, 1941), a glass rod 1.5 mm. in diameter, was fastened by wax. On either side of it were placed four semicircular thicknesses of blotting-paper soaked in the salt solution giving the required humidity. A perforated zinc false floor, 11 cm. in diameter, covered with organdi, was supported about 1 mm. above the blotting-paper by six very small pieces of glass. The arena was enclosed by the lid of a Petri dish 9.5 cm. in diameter and 5 mm. deep. A glass rod, 2 mm. in diameter, embedded in wax, was fastened across the roof of the arena to minimize the area of contact between the air on each side. A large Petri dish 12 cm. in diameter, covered the entire apparatus so as to isolate the arena from the outside atmosphere.

The following salt solutions were used for controlling humidity at 25 °C. (ADAMS and MERZ, 1929 ; BUXTON, 1931 ; BUXTON and MELLANBY, 1934) : K_2SO_4, 98% ; KCL, 83% ; $Ca(NO_3)_2$, 50% ; KH_2PO_4, 95% ; NaCL, 75% ; $MgCL_2$, 33% ; Neutral Na-tartrate, 92% ; NH_4NO_2, 62% ; K-acetate, 18%. The humidities given by these salts were checked before each set of experiments.

It was assumed that the humidity above the floor was that given by the salt below, and that the steepest part of the humidity gradient would be in the zone along the median line. Once set up, the apparatus was left about half an hour for the humidity equilibrium to become established (HAFEZ, 1950), and then the larva was introduced by slightly lifting the cover. The disturbed equilibrium would be reestablished soon after, according to SWEETMAN (1933).

A single fresh larva was used for each experiment, and 12 experiments were carried out to test the reaction of the larva to a given pair of alternative humidities. Half way through these experiments, the two sides of the arena were interchanged in order to eliminate any possible bias of the larva towards one particular side. Each experiment lasted from 5 to 30 minutes.

The tracks made by the larva on the floor of the arena were copied on a sheet of paper alongside the apparatus, and half minute intervals were marked on the tracks. By this means the time spent by the larva on the two sides of the arena was recorded. The intensity of the reaction was expressed when required as the excess percentage

$$100 \left(\frac{W - D}{W + D} \right)$$ (Gunn and Cosway, 1938), where W and D were the time

spent by the larva on the wetter side and drier side respectively, the time spent by the insect in the middle zone was ignored.

The larvae used in these experiments were obtained from a standard culture (reared on horse dung, the relative humidity of which was about 100%) kept at temperature of about 30 °C. The experimental larvae were of nearly the same age and size and care was taken that all experimental larvae were in the same physiological condition.

Experiments and results

Extreme alternatives.

The reaction of the larva towards wet and dry surfaces was tested. This was done by dividing a circular sheet of blotting-paper into two equal halves. One half was saturated with distilled water, the other left dry (by covering it with calcium chloride powder) and the arena was left open above, and the larval tracks were observed. In all cases the larvae persistently avoided the dry side and spent nearly all its time on the wet side (Fig. 1 A).

The prepupating larva, on the other hand, spent more time on the moister side (Fig. 1 B) ; on the drier side, the larva moved rapidly following a convoluted course. When the larva was allowed to choose in the alternative chamber between two high relative humidities (e.g. 100 or 90%) and a high and medium relative humidities (e.g. 83 or 62%), a marked reaction became obvious, the larva strongly avoided the moister side (Fig. 1 C), complete avoidance of the drier side, however, was observed with the latter pair of alternatives (Fig. 1 D).

Uniform humidities.

The behaviour of the larva at uniform humidities was tested in a series of control experiments. The relative humidities used were 100, 98, 50 and 33%, each in a single treatment. At high humidities (e.g. 98%), the larva walked straight around the wall of the arena at an

average rate of 4.5 cm./min. "An intermediate behaviour was obtained at intermediate relative humidities (e.g. at 75%); the larva walked in a more or less convoluted course with an average rate of 6 cm./min. At low relative humidity (e.g. 33%), the larva moved erratically at a higher rate (8.5 cm./min.).
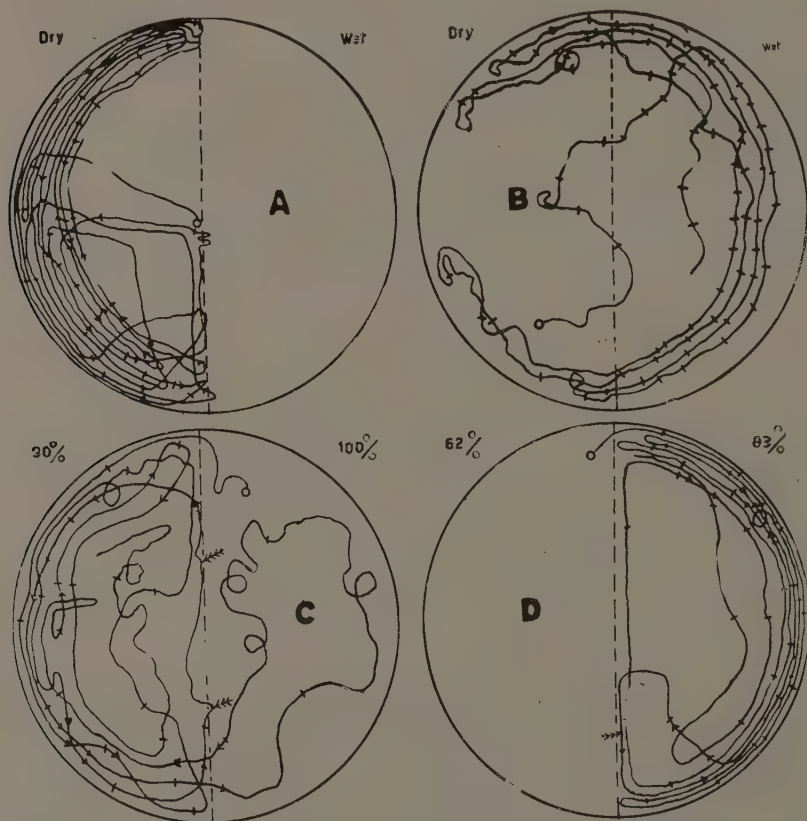
FIG. 1: Reactions of the larva to dry and wet surfaces (A, feeding stage; B, prepupating stage; C, reactions of the prepupating larva towards high relative humidities (100 or 90% R.H.); D, reactions of the prepupating larva towards high and medium relative humidities (83 or 62% R.H.)).

Prepupating larvae, on the other hand, followed a convoluted course at low and very high relative humidities (3? and 98%), but walked in straight lines at 83% R.H., moreover the movements of the larva were quicker at 98 and 33% R.H. However, the larva was more rapid at 33% than at 98% R.H.

Alternative humidities.

When the larva was given the option of relative humidities of 92 and 100%, it spent most of the time on the moist side, showing a marked avoidance of the drier side. The intensity of the reaction expressed as excess percentage on the moist side was thus about 100%. The larvae when passed the mid-line with about 1 cm., often turned

FIG. 2. A, reactions of feeding larva when offered the alternatives 100 or 92% R.H.; B, reactions of prepupating larva offered the alternatives 93 or 95% R.H.

back and regained the moister side (Fig. 2 A). Sometimes, however, some larvae made their turns too late and continued on the drier side, moving erratically in a convoluted course until they eventually regained the moister zone. On entering the latter zone, the larvae never returned to the drier side. In addition, the following pairs of humidities were tested : 100 or 98%, 100 or 95%, 100 or 92%, 98 or 95%, 98 or 92%, 92 or 83%, 95 or 75%, 95 or 50%, 83 or 50%, 75 or 50%, 62 or 50%, 83 or 75%, 75 or 62%, 50 or 25%, 50 or 20%, 50 or 18%, 50 or 10%, 25 or 10%.

Larvae introduced into relative humidities above 50%, i.e. 62 or 50%, 75 or 95%, 75 or 50%, 83 or 50% and 95 or 50%, showed a marked reaction towards the moister side (Fig. 3 A), but the intensity of this reaction depended on the humidity difference between th alternatives offered. The greater the difference, the stronger the avoidance of the drier side. Also, it was obvious that the higher was the humidity range, the greater was the intensity of reaction. For instance, the

reaction intensities to about the same humidity difference at 75 or 83, '83 or 92 and 92 or 100% R.H. was about 67, 73 and 100%, respectively.
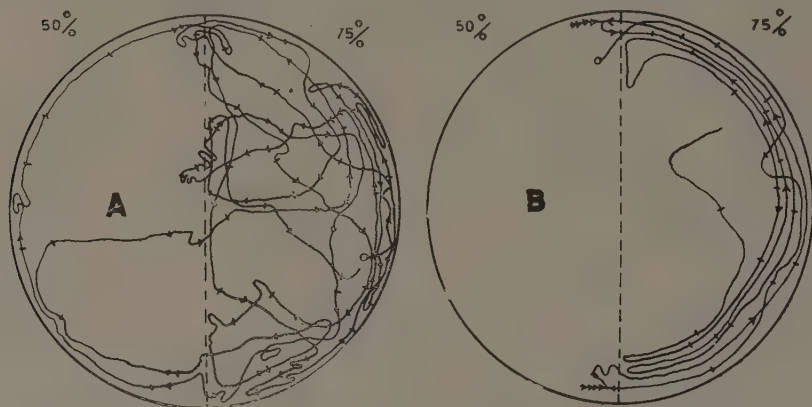
FIG. 3: Reactions of the larva when offered the alternatives 50 or 75% R.H. (A, feeding stage; B, prepupating stage).

Within the upper range, from 90-100% R.H., smaller humidity differences such as 2% (at 98 or 100% R.H.), 3% (at 95 or 98% R.H.), 5% (at 95 or 100% R.H.) or 6% (at 92 or 98% R.H.) were sufficient to produce clear avoidance of the drier side (Fig. 4 A). LARSEN and THOMSEN (1940), showed experimentally that the larvae of *Stomoxys*
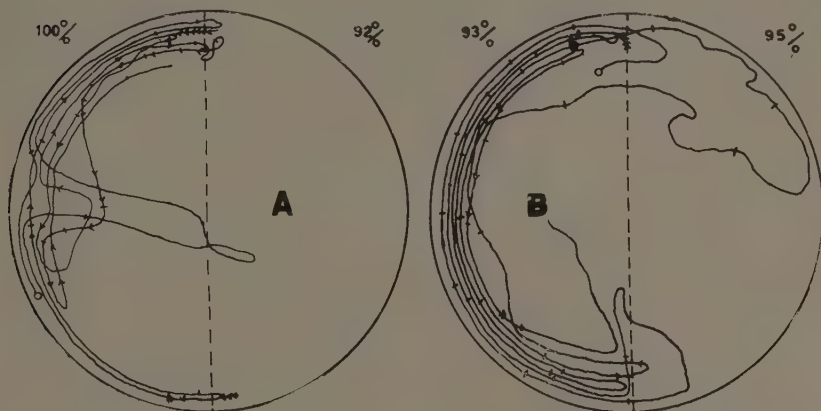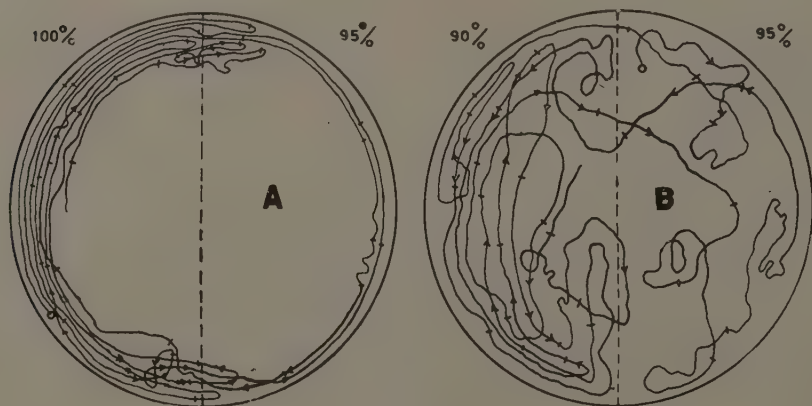

FIG. 4: A, reactions of feeding larva when offered the alternatives 100 or 95% R.H.; B, reactions of prepupating larva when offered the alternatives 95 or 90% R.H.

calcitrans can only live normally at the highest atmospheric humidities ; below 100-97% R.H., they died within a short time.

Below 50% R.H., no preference was shown by the larva when offered alternativese of 10 or 25, 25 or 50, 20 or 50% R.H. A weak reaction, however, was obtained when they offered 18 or 50% R.H., this weak reaction became strong when 18% R.H. was replaced by 10% R.H. (Fig. 5). Howeveer, it seems that this apparent low sensitivity to humidity at lower humidity range (below 50% R.H.) might be due to failure in the operation of the orientation mechanism under adverse physiological conditions rather than to real indifference to humidity . (LEES, 1943, in wireworms). The same phenomenon was observed in

FIG. 5: Reactions of the feeding larva within the range 10-50% R.H.

Culex (THOMSON, 1938), in *Tenebrio* (PIELOU and GUNN, 1940), in *Pediculus* (WIGGLESWORTH, 1940), in *Musca domestica* (HAFEZ, 1950) and in *Musca sorbens* (HAFEZ and ATTIA, 1958) which are all sensitive to humidity within the higher humidity range.

In the pre-pupating larva, it was found that the larva preferred a medium relative humidity to a low one, and preferred relatively high relative humidity (83%) to a medium (62%) or high relative humidity (95%). Thus when the larva was allowed to choose between (75 or 50% R.H.) and (83 or 62% R.H.) it strongly avoided the drier side (Fig. 3 B). On the other hand, when given a choice of (95 or 83% R.H.), it avoided the moister side (Fig. 2 B).

In the presence of 90% R.H., all higher humidities were avoided (Fig. 4 B). The intensity of avoidance depended on the difference

of the alternative humidities offered.   For instance, the reaction in-
tensities to differences of 3% (at 95 or 98% R.H.), 5% (at 95 or 90%
R.H.) and 10% (at 100 or 90% R.H.) were about 29, 33 and 83%, res-
pectively.

In the presence of 83% R.H., all higher humidities were avoided
Figs. 2 B and 6 A and B), and the intensity of the avoidance depend-
ed on the humidity differences of the alternatives offered, e.g. at a
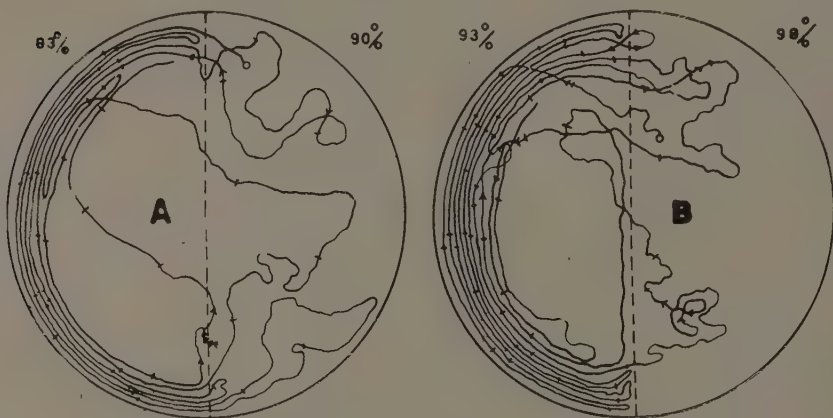
FIG. 6: A, B, reactions of prepupating larva to humidity differences within
the range 83-98% R.H.

difference of 7% (83 or 90% R.H.), 12% (83 or 95% R.H.) and 15% (83
or 98% R.H.), the reaction intensities of the prepupating larva were
66, 82 and 91%, respectively.

When the prepupating larva was offered, a choice of 83 or 75%
R.H., the larva seemed indifferent (Fig. 7 A), and walked in a more
or less straight course in the drier side.

When given the choice of 75 or 62% R.H., and 62 or 50% R.H.,
the larva strongly avoided the drier side (Fig. 7 B and C).

From the foregoing data, it seems that the humidity range pre-
ferred by the prepupating larva in these experiments lies between
75-83% R.H.   In the presence of this range, all humidities above and
below are avoided by the larva.   Comparing these results with those
of the feeding larva, we find that the two stages have a high sensiti-
vity to high humidities but it is higher in the feeding larva.   Also, it
is clear that the prepupating larva does not lose the response at the
upper humidity range.

Comparing these results with those of HAFEZ (1953) on *M. domestica* larva, we find that the humidity range preferred by *Stomoxys calcitrans* prepupating larva, is distinctly higher (73-83% R.H.), than that preferred by *Musca* prepupating larva (50-62% R.H.). Moreover *Stomoxys* larva, unlike *Musca* larva seems more sensitive to high humidity. For instance, the former is sensitive to humidity differences above 90% R.H., while the latter seems to lose the response at the upper humidity range (above 75% R.H.).
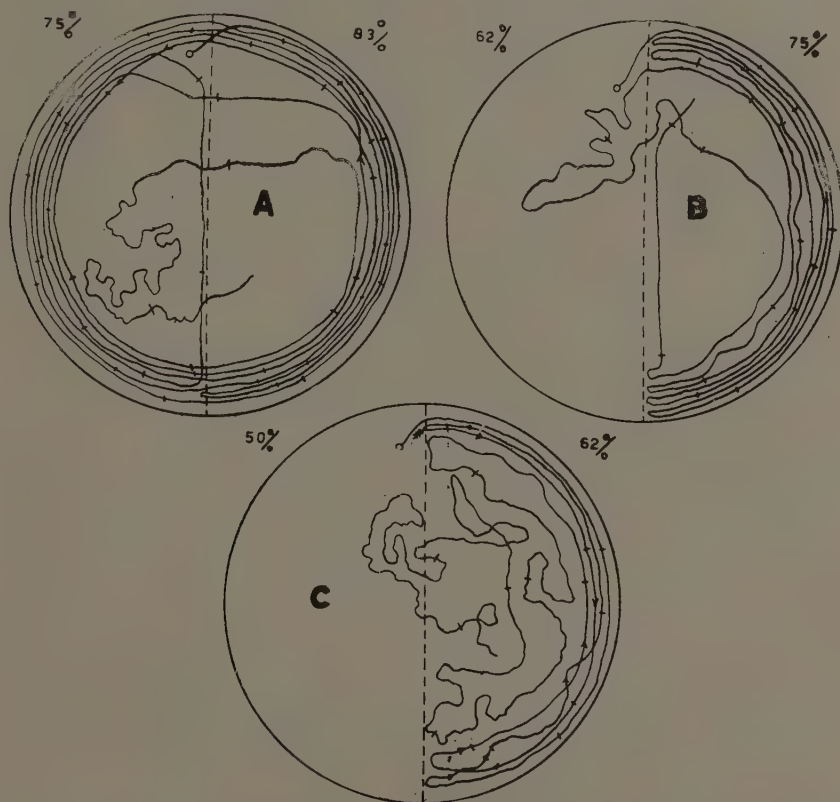
FIG. 7: A, reactions of prepupating larva showing no preference when offered a choice of 75-83% R.H.; B, track of prepupating larva showing strong avoidance to the drier side when offered a choice of 62 or 75% R.H.; C, reactions of the same larva to 50 or 62% R.H.

Pre-conditioning.

The feeding larvae were kept at 60% R.H. for five hours and then offered an alternative in which one side of the humidity chamber was

kept at 95% R.H. The lower humidity of the other side in the alternative chamber was the same as that at which the larva had been previously kept. No marked effect due to pre-conditioning was observed and the larva showed a constant avoidance of the drier side. The same was also observed with the prepupating larva; pre-conditioning had no effect upon the behaviour of the larva.

Mechanism of orientation.

The larva when crossed the wet side to the dry side, the rate of movement increased, till the larva returned to the moist side. This is an example of ortho-kinesis, involving a variation in the linear velocity of the larva. On the other hand, the larva when entered the dry zone, no longer moved in straight lines along the periphery of the arena, but instantly changed its course in a devious manner till it regained the wet side. This is an example of klino-kinesis, manifesting a change in the rate of random turning, or angular velocity. This rate of random turning depends on the intensity of stimulation. When the larva was offered high and very low humidities, it was noticed that, on reaching the middle zone it persistently avoided the dry side and recoiled back to the moister side. This recoiling back is a directed reaction or "taxis". The same mechanism was reported by HAFEZ (1950), working on *Musca domestica* larva and described as klino-tactic reaction, involving comparison of intensities of stimulation at successive points of time. Later, HAFEZ and ATTIA (1958) reported the same klino-tactic reaction in the larva of *Musca sorbens*. When the larva entered low humidity ranges, another directed reaction became obvious; the larva moved backwards rapidly and regained the moister zone, then it recoiled and continued its movement there. By this reaction (hygro-phobo-taxis) the larva always avoids the lower humidity and passes over again into the more favourable zone. It seems therefore that there are two main types of reactions, namely, kinesis (ortho- and klino-kinesis) and taxis (klino- and phobo-taxis) by which the larva avoids the lower humidity and succeeds to regain the favourable zone.

The same mechanisms seem also to contribute to the general humidity behaviour of the prepupating larva in the alternative chamber.

III. REACTIONS TO TEMPERATURE

Reactions of insects to temperature have been studied by a number of workers notably GUNN (1934, 1935), KRIJGSMAN (1931), THOMSON

(1938), DEAL (1941), WIGGLESWORTH (1941), GUNN and WALSHE (1942), FALCONER (1945), DAKSHINAMURTY (1948), HAFEZ and ATTIA (1958) and HAFEZ and MAKKY (1959).

The apparatus used for studying the temperature reactions was similar to that devised by WIGGLESWORTH (1941), with some modifications. Hot and cold water circulated in two copper tanks, each $20 \times 20 \times 20$ cm. The two tanks were separated by a sheet of asbestos about 3 mm. thick, and held together by a copper strip. The latter was lined internally with a similar strip of asbestos 1 mm. thick so that in the case of using high and low temperatures, no heat would be conducted by the copper strip, from one tank to another. The temperature was adjusted by micro-burners or ice for the warm and cold sides respectively. From each tank, a thermometer projected out, the bulb of which was inserted close to the surface (internally), on which the arena was enclosed by a glass ring 9 cm. in diameter. At the uniform temperature experiments, the arena rested on one tank, while testing two alternative temperatures, half of the arena rested on one tank and half on the other. The experiments were made either at 100% R.H. or at 100% R.H. with water in direct contact with the larvae under test. In the later case, a moistened floor was made by blotting-papers saturated with water. The glass ring was roofed by a glass plate containing a round small hole in the middle, and the whole arena was enclosed by an inverted Petri dish. The apparatus was rendered air tight and when set up, a larva was introduced through the hole in the glass roof. The reactions of the larva to temperature was then examined.

Experiments and results

Extreme alternatives.

The humidity was kept constant at 100% R.H. Larvae were first given the choice of 25 or 37 °C., they spent nearly all their time in the cooler side and strongly avoided the higher temperature. When they were offered the choice of 25 or 10 °C., a marked avoidance of the lower temperature appeared but not so strongly as in the case of the higher temperatur e(Fig. 9 A and B). When given an alternative of 10 or 37 °C., the larvae moved rapidly and erratically on both sides and later spent most of its time in the middle zone of the arena (Fig. 8).

Uniform temperatures.

The following uniform temperatures were tested, each in one experiment : 10, 18, 20, 23, 25, 27, 28, 30, 31, 32, 33, 35, 37, 39 and 40 °C.

The tracks of the larvae were almost straight, from 20-31 °C., less so below 20 °C., and from 33 up to 35 °C. It was also obvious that the rate of movement of the larva was directly proportional to temperature, increasing with rising temperature.
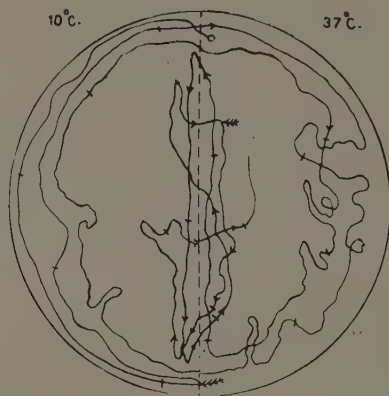
FIG. 8: Tracks followed by feeding stage at low and high temperatures.
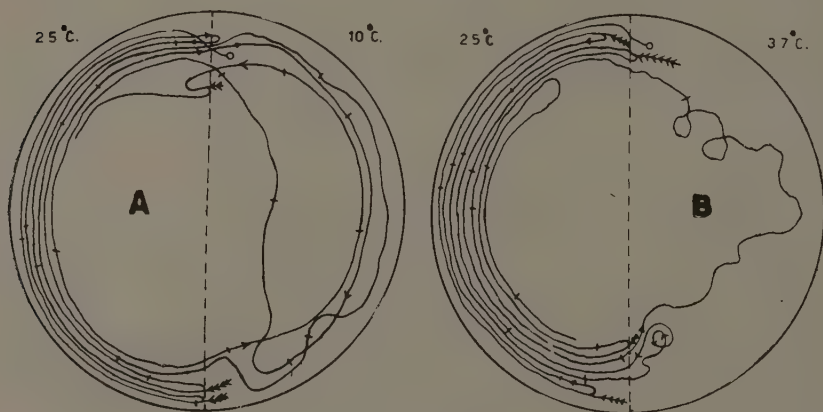
FIG. 9: Tracks followed by feeding larva showing reactions to (A) 25 or 10°C. and (B) to 25 or 37°C.

Alternative temperatures.

The temperature was kept constant on one side at 25 °C., and progressively lowered or raised on the other side. In other experiments it was kept constant on one side at 30 °C., and raised on the

other side ; or kept constant at 20 °C., and lowered on the other side. The purpose of these experiments was to find the threshold high and low temperatures which elicit a response and find also the optimum temperature of the larval activity.

Above 25 °C., the larva was indifferent to 3 or 4 degrees, so no definite reaction was obtained at 25 or 28 °C. and 25 or 29 °C. However, the larva detected a difference of 5 or 6 degrees. Thus when given a choice of 25 or 30 °C., or 25 or 31 °C., the larva weakly reacted to the higher temperature (Fig. 11 A) and the intensity of reaction was higher at 25-31 °C. However, the larva showed clear avoidance of the higher temperatures when offered the choice of 25 or 33 °C., 25 or 34 °C., 25 or 37 °C., and 25 or 39 °C., the avoidance was very strong at 25 or 37 °C. and 25 or 39 °C.

Above 30 °C., larvae were indifferent to 1 °C., thus they were indifferent when given choice of 30 or 31 °C. At 30 or 32 °C., or 30 or 33 °C., the larvae showed slight avoidance of the higher temperature. This avoidance became strong with a choice of 30 or 35 °C. and very strong with 30 or 37 °C. When the temperatures used were entirely above 35 °C., larvae were sensitive to a difference of 1 °C., avoiding the higher temperature.

Below 25 °C., on the other hand, the larva showeed no proference when given the choice of 25 or 20 °C. When the temperature on the cooler side was lowered to 15 °C., a weak reaction occurred with slight avoidance of the lower temperature (Fig. 10 A). This reaction became still stronger at 25 or 13 °C., or 25 or 10 °C. When

FIG. 10: Tracks followed by the larva, showing first avoiding reactions to low temperature (A, feeding larva; B, prepupating larva).

the larva was given the choice of 20 or 10 °C. or 20 or 8 °C., it avoided the lower temperatures but the intensity of avoidance was greater in the latter case.

Below 15 °C., larvae seemed much less sensitive. For instance, while there was a strong reaction to a difference of 1 °C. at 35 or 36 °C., there was none to the same temperature difference at 15 or 14 °C., 14 or 13 °C., 13 or 12 °C., 12 or 11 °C., 11 or 10 °C. or even 10 or 9 °C. From these results, it appears that under the present experimental conditions, the larva of *Stomoxys calcitrans,* has a preferred temperature range (thermopreferendum) which usually lies between 15-30 °C. Also the sensitivity of the larva to temperature increases above 35 °C. and decreases below 15 °C. ; temperatures above 31 °C. and below 8 °C. are avoided by the larva, the avoidance being stronger in the former case.

When the above experiments were repeated at 100% R.H., and with a moistened floor, so that the larvae were in direct contact with water, they were indifferent to greater temperature differences, e.g. 25 or 32 °C. Very slight avoidance of the higher temperature began when the larva was offered 25 or 34 °C. and the avoidance became more obvious at 25 or 37 °C. Comparing these results obtained in the alternative chamber in (a) moist air, (b) moist air with water in contact with the larva, it seems that the indifference range above 25 °C., was higher in moist air with water than in moist air alone. In other words, the larva seemed to prefer a low temperature in moist air and did not avoid high temperature when water was in contact with it. It was found that the definite indifference zone was wider (25-37 °C.) in the latter case than in moist air alone (25-30 °C.).

Comparing these results with those of HAFEZ (1950), on *Musca domestica* larva, we find that the zone of indifference of the latter is somewhat greater than that of *Stomoxys,* being 25-33 °C., at about 100% R.H. and 25-39 °C at saturation with moist surface. Most recently HAFEZ and ATTIA (1958) working on the behaviour of *Musca sorbens,* found that the indifference range of the latter (with water in contact) was 25-40 °C., which is greater than those of *domestica* and *Stomoxys.*

Experimenting with prepupating larvae, to test their temperature reactions, the temperature was kept in most cases constant at 20 °C. on one side of the alternative chamber and changed on the other side.

Below 20 °C., the larva was indifferent when offered a choice of 20 or 17 °C., but a weak avoiding reaction of the cooler side began to

appear when using 20 or 15 °C. (Fig. 10 B). The larva showed again no preference at 20 or 24 °C., but at 20 or 25 °C., the warmer side was slightly avoided (Fig. 11 B). When the larva was offered 26 or 30 °C., a strong avoiding reaction of the warmer side was observed. On the other
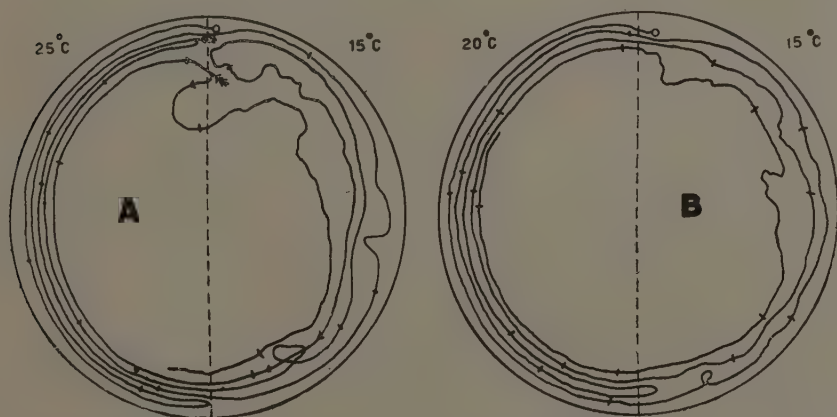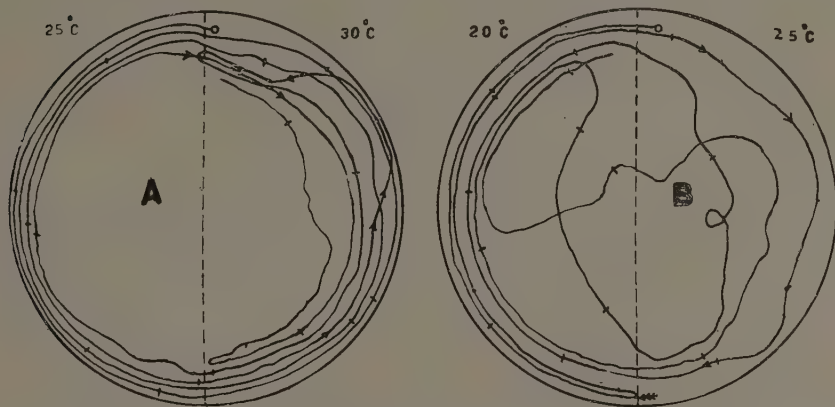

FIG. 11: Tracks followed by the larva, showing first avoiding reactions to high temperature (A, feeding larva; B, prepupating larva).

hand, the larva was indifferent to 15 or 10 °C., or 15 or 9 °C. A slight avoidance of the lower temperature was observed at 15-8 °C. So it appears that the larva has a preferred temperature range, which lies between 15 and about 25 °C. It was also noticed that the larva was more sensitive to higher temperature ranges than lower ones. Below 15 °C., however, the larva was not sensitive to 6 °C. differences (e.g. 15 or 9), at 15 or 8 °C., however, very weak reaction appeared.

From the foregoing results, it appears that the preferred temperature ranges of both the feeding and prepupating larvae coincide in their lower limits (15 °C.). Also it was obvious that there was a slight difference between the preferred temperature range of the feeding larvae (15-30 °C.) and that of the prepupating larvae (15-25 °C.). These results seem to be similar to those found by HAFEZ and ATTIA (1957) on *Musca sorbens* larvae. They found that there was a slight difference between the prefered temperature range of the feeding larva (16-29 °C.), and that of the prepupating larva (16-25 °C.), which both also coincided in their lower limits (16 °C.). On the other hand HAFEZ (1950 and 1953) working on *Musca domestica* found that the feeding larva has a definite range of thermopreferendum, generally

extending between 15-25 °C., while that of the prepupating larva be-
tween 8-20 °C.

Pre-conditioning.

Larvae were pre-conditioned either at 37 °C. or at 10 °C., and
their reactions to temperature were then tested at alternatives of 37
or 25 °C. and 10 or 25 °C. In both cases, the larvae showed strong
preference of 25 °C. zone. So it seems that pre-conditioning as in
the case of humidity, has no effect on the behaviour of the larva to
temperature. The same finding was obtained with prepupating
larvae.

Mechanism of orientation.

Orthokinesis, klinokinesis, klinotaxis and thermo-phobo-taxis are
again the mechanisms which are involved in the temperature reac-
tions of the larva. Orthokinesis is manifested at uniform as well as at
alternative temperatures. Klinokinesis was observed when the larva
crossed to the unfavourable side of the arena. Klinotaxis came into
action at steep temperature gradients. Photo-taxis was well demons-
trated as the larva crossed to or sometimes approached the unfavour-
able side. It was also noticed that this retrogressive mode of locomo-
tion which is usually performed on encountering the adverse zone, is
soon followed by normal progressive locomotion in the favourable
zone. This combination of progression and retrogression was observ-
ed in the three larvae of *Stomoxys* in nature.

IV.   REACTIONS TO SMELL

The method used for testing the reactions of the larva towards
smell was roughly the same as that used in the humidity experiments.
The arena was left open above. The blotting-papers were soaked in
the dilute solutions of whatever substances were to be tested as adours.
The relative humidity in all experiments was near saturation (about
98% R.H.). The temperature was kept more or less constant at 25 °C.
It was assumed that under such conditions, the warm odours would
be carried upwards by the convection currents and form in still air
a steep gradient in the median zone of the arena (WIGGLESWORTH,
1941). The following odours were used as they might be expected to
form part of the normal environment of the larva   Ammonia, acetic
acid, acetone, ethylamine, tri-methyl-amine, formic acid, butyric acid
and propionic acid. All these substances were used at a concentration
of 1%. The concentration of these solutions was kept constant
throughout the experiments. The reactions of the larvae were also

tested towards some fresh natural breeding substances such as cow dung and horse dung, in addition human urine was tested. These, with the exception of the latter, were diluted and filtered and the blotting-papers saturated with the filtrate.

Experiments and results

When one side of the arena contained horse or cow dung and the other side was untreated, the larvae strongly avoided the neutral side. The avoidance was strongest with the horse dung, the larvae returning to that side almost immediately after crossing into the neutral side (Fig. 12 A). The tracks of the larvae were usually straight on the scented side and convoluted on the neutral side. Also in almost all cases, on approaching the neutral zone, the phenomenon of retrogression was clear. When odours emanating from horse dung and cow dung were offered as alternatives, the former was slightly preferred to the latter.
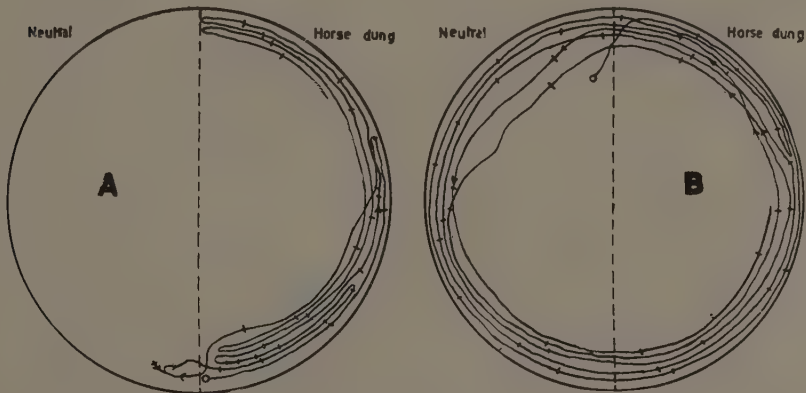
FIG. 12: Reactions of the larva to horse dung (A, feeding larva; B, prepupating larva).

On the other hand, when human urine was used in one half and the other side was untreated, the larvae strongly avoided the treated side (Fig. 15 B). When one side of the arena contained ammonia, acetone, ethylamine or trimethylamine and the other side was untreated, the larva always favoured the scented side (Fig. 13 A). On the other hand, the reverse occurred when propiopic, butyric, acetic or formic acids were used, the larvae followed a more or less convoluted course when entered the scented side. However, the response

was strongest towards the smell of propionic acid (Fig. 14 A), follow-
ed by formic acid. When acetic acid was used as an alternative to
ammonia, the former was strongly avoided (Fig. 15 A). When the
larvae were offered ammonia and acetone they were almost indif-
ferent to either side of the arena.
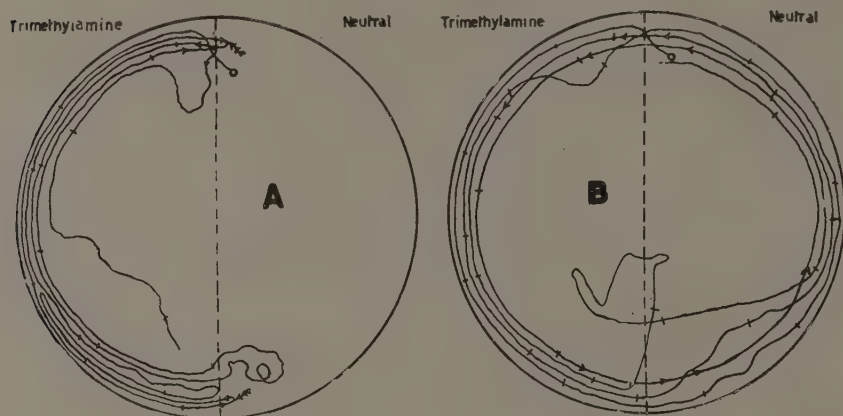
FIG. 13: Reactions of the larva to trimethylamine (A, feeding larva; B.
prepupating larva).

These results are generally in agreement with those of HAFEZ
(1950) on *Musca domestica* larva.

Experimenting with prepupating larvae, when horse dung, am-
monia, acetone, ethylamine or trimethylamine were on one side of the
arena each at a time and the other left neutral, the larvae were almost
indifferent (Figs. 12 B and 13 B). When one side had acid and the
other was untreated, the larvae slightly avoided the acid scented side
(Fig. 14 B), but some were completely indifferent to the smell. How-
ever, when the larva was offered the choice of ammonia and acetic
acid, a weak reaction was observed towards the ammonia side.

From the foregoing results, it seems that the olfactory sense of
the prepupating larva has been diminished as compared with that of
the feeding larva. This was demonstrated by the weak avoiding re-
action of the larvae to the repellent smell of acetic acid or its complete
disappearance. A similar change in the olfactory behaviour of
M. domestica larva at the prepupating stage was reported by HAFEZ
(1953). The same phenomenon was also observed in *Musca sorbens*
larvae (HAFEZ and ATTIA, 1958). This change in the olfactory sense of

the prepupating larva and its low ability to perceive odours when it ceases to feed were interpreted by HAFEZ (1953). The latter author pointed out that the hormones produced by the lateral parts of the ring gland which suddenly grow when the larva stops eating and re-
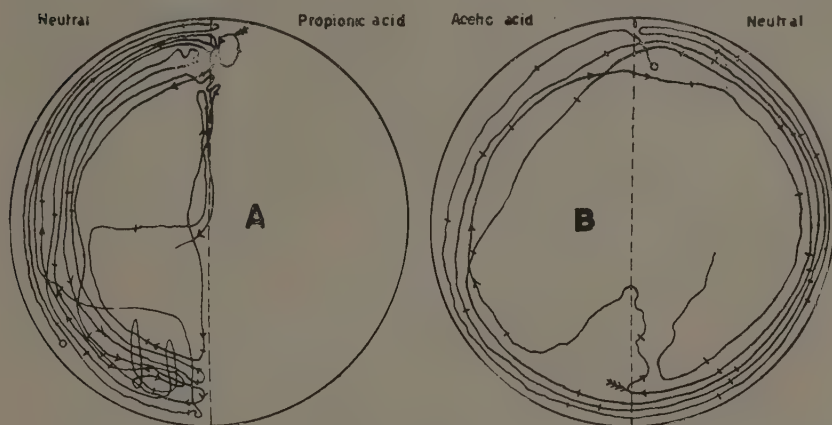
FIG. 14: Reactions of (A) feeding larva to the smell of propionic acid and of (B) prepupating larva to the smell of acetic acid.
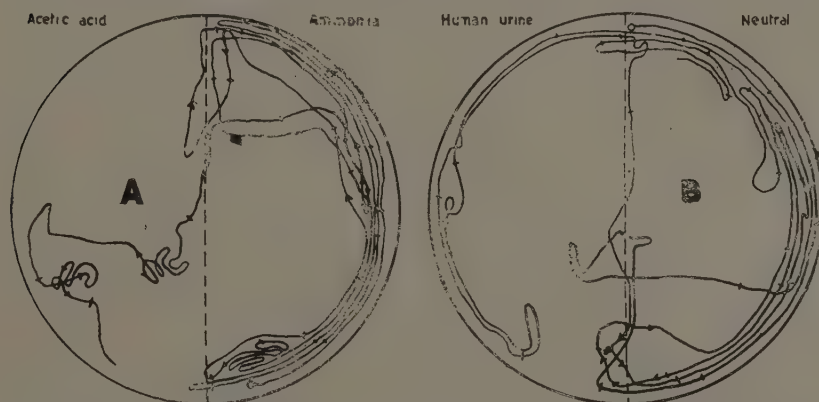
FIG. 15: A, reactions of the feeding larva to the smell of acetic acid and ammonia; B, tracks of the same larva where half arena provided smell of human urine and half left untreated.

acting to smell (BOLWIG, 1946, on *Musca domestica*) not only initiates the stopping of feeding, but probably has also such influence as to inhibit or eliminate the reaction of the larva to smell.

Mechanism of orientation.

Klinokinesis was observed when the larva crossed the favourable scented side to the adverse zone. The larva followed an irregular course on the unfavourable side and returned to the preferred zone. A directed reaction (taxis) was also marked out when the larva was subjected to a very repellent smell such as propionic acid. The larva on reaching the middle zone, persistently avoided the acid scented side and recoiled back to the unscented side ; this was a klinotactic reaction. In many cases, the larva instead of recoiling back, moves backwards with its hind extremity till it reaches the favourable zone, then it recoils and continues its movement ; this is a phobotactic reaction. All these mechanisms were found to operate the prepupating larvae as well.

V.   THE REACTIONS OF THE LARVA
AND THE NORMAL ENVIRONMENT

The conclusions arrived at from the foregoing experimental studies on the behaviour of the larva of *Stomoxys calcitrans* may have an obvious bearing on some of the present knowledge of the life of *Stomoxys* in its normal environment. In nature, larvae are commonly found in moist decaying leaves and dung of cattle and horses especially when mixed with straw and urine. The average temperature recorded inside such larval microclimates was found to lie between 15 and 31 °C. ; above 31 °C., however, larvae were very rare, undersized and moved erratically and agitatedly in the breeding media. According to THOMSEN and HAMMER (1936), larvae of *Stomoxys calcitrans* are generally found in breeding media with temperatures ranging between 20 and 26 °C. and seldom rise to 30 °C. or more. Experimentally, the thermopreferendum of the feeding larva was found to lie between 15-30 °C., a range which actually occurs in the larval habitat.

Prior to pupation, the larva does not migrate to the edge of the breeding medium or the surrounding earth as the larva of *Musca domestica* or *M. sorbens* usually does. The striking preference of the prepupating larva to the same breeding place of the feeding larva is not at all surprising. This can be seen from the slight difference between the preferred temperature range of the feeding larva (15-30 °C.) and that of the prepupating larva (15-25 °C.), which both coincide in their lower limit (15 °C.). The latter range (15-25 °C.) actually occurs in the feeding larval micro-climate, where numerous pupae are com-

monly found. LARSEN and THOMSEN (1940), reported that the larvae of *Stomoxys calcitrans* usually live in breeding media with more constant conditions than that of *Musca domestica,* and there may be a connection between the more constant conditions under which *Stomoxys* develops and the long larval life, while *M. domestica* develops in media which are subject to rapid transformation processes. The *domestica* larvae, on the other hand, breeding principally in horse manure, occur in the upper layers with temperatures ranging between 30-40 °C., and prior to pupation they seek cooler sites in the edge of the manure heap or the surrounding earth which is cooler and where the temperature is 20-25 °C. (THOMSEN, 1937). HAFEZ and ATTIA (1958) have shown that the larva of *Musca sorbens* migrates beneath the stool prior to pupation but they found that this prepupal migration does not seem to be due to temperature since as in *Stomoxys,* there is a slight difference between the preferred temperature range of the feeding larva (16-29 °C.) and that of the prepupating larva (16-25 °C.) which both again coincide in their lower limit. Therefore, it appears that although *Stomoxys* and *M. sorbens* larvae agreed in some aspects, they differed in their behaviour just before pupation. Thus the former pupate under the same conditions of the feeding larval stage, while the latter migrates below the stood before pupation.

The striking preference of the larva of *Stomoxys* for higher air humidities and the fact that the feeding larvae favour humidities near saturation above all other lower ones is in conformity with the larval micro-climate which is typically moist. According to LARSEN and THOMSEN (1940), the larvae of *Stomoxys calcitrans* can only live normally at the highest atmospheric humidities ; velow 100-97% R.H., they die within a short time. The fact that the feeding larva showed a greater range of temperature preference when it was in direct contact with water in the arena, may interpret the behaviour of the larva in its natural habitat. Thus in summer months, with the rise of temperature, the larva prefers those media of higher moisture content and the reverse is true in winter. An inspection of table (36), shows that the water content of the larval micro-climate increases gradually with the advent of summer reaching its maximum (78%) in August (33 °C.) and its minimum (55%) in January when the temperature of the larval microclimate was 15° C.

According to repeated field observations, the larva of *S. calcitrans* does not migrate to drier strata before pupation, but pupates in the same humid medium of the feeding larva. This is not at all surprising as it was found experimentally that the prepupating larva of

Stomoxys in contrast to that of *M. domestica* (HAFEZ, 1953) and *M. sorbens* (HAFEZ and ATTIA, 1958) prefers a high humidity range (75-83% R.H.). In the presence of this range, all lower and higher humidities are avoided. Also the prepupating larva of *Stomoxys*, unlike *domestica* or *sorbens*, was responsive to humidity differences at the upper humidity range above 90% R.H.

Comparing these results with those of the prepupating larvae of *M. domestiva* (HAFEZ, 1953), it is found that the latter has a hygropreferendum ranging between 50% and 62% R.H. Also they seem to lose the response to air humidity at the upper humidity range above 75% R.H. These agree with the field observations, as when about to pupate, the larva of *domestica* leaves the juicy part of the breeding medium to drier regions (HAFEZ, 1953). The same is true in the case of *M. sorbens*, i.e. prior to pupation, the larva of this species leaves the moist inside of the stool and seeks drier sites underneath where the relative humidity usually ranges between 50-60% R.H., the preferred relative humidity range of the prepupating larva (HAFEZ and ATTIA, 1958).

Therefore, it may be concluded that unlike *M. domestica* and *M. sorbens*, *Stomoxys* larvae undertake no migratory movements and pupate in the same medium of the feeding larva. THOMSON (1937), reported that the puparia of *S. calcitrans* were found in mixture of straw and dung in the larval micro-climate and under the same conditions and apparently, the larvae did not migrate to drier surroundings prior to pupation.

The strong preference of the larva for the smell of horse dung is in accordance with the results obtained from breeding experiments and field observations. The preference for ammonia and the like substances is consistent with the fact that the larvae prefer a mixture of straw and dung especially when wetted with urine, where this substance is produced.

The pupation of the larva of *Stomoxys* in the odoriferous larval habitat does not seem to be due to an olfactory response, since experimentally, the prepupating larva was unable to differentiate between different smells offered. Therefore, it seems that temperature and humidity and not the smell of the breeding medium are the dominant factors which possibly induce pupation in the same micro-climate of the feeding larva.

It is possible to visualize the part played by the various mechanisms of orientation demonstrated in the laboratory behaviour experiments, in the normal environment. *Stomoxys* eggs are laid in crevices

on the surface of the breeding medium. On hatching into larvae, the latter immediately burrow inside the medium and disappear. This may be due to klino- or phobo-tactic response, which leads the larva to a favourable zone. The migration of the larva to higher humidities with the advent of summer or the reverse in winter may be due to the operation of orthokinesis, klinokinesis, klinotaxis or phobo-taxis, depending on the steepness of the gradient. These reactions lead the larva into the optimal conditions of temperature, humidity or smell.

VI. THE BEHAVIOUR OF STOMOXYS CALCITRANS LARVAE AS COMPARED TO THOSE OF MUSCA DOMESTICA AND MUSCA SORBENS

The results obtained in the course of the present work, have clearly demonstrated that the behaviour of *Stomoxys* larvae (mainly the prepupating), is different in some aspects from those of *Musca domestica* (HAFEZ, 1950 and 1953) and *Musca sorbens* (HAFEZ and ATTIA, 1958). Comparison between the different larvae, mainly, as far as the points of contrast, are outlined as follows :

(1) The prepupating larva of *Stomoxys* prefers a higher humidity range than that of *M. domestica* or *M. sorbens,* being 75-83% R.H. for *Stomoxys,* 50-62% R.H. for *M. domestica* and 50-60% R.H. for *M. sorbens.*

(2) The prepupating larva of *Stomoxys* seems not lose the response to air humidity at the upper humidity range above 90% R.H. For instance, the reaction intensities to differences of 3% (at 95 or 98% R.H.), 5% (at 95 or 90% R.H.) and 10% (at 100 or 90% R.H.) were about 29, 33 and 83%, respectively. On the other hand, the prepupating larva of *M. domestica* seems to lose the response to air humidity at the upper humidity range above 75% R.H. (HAFEZ, 1953).

(3) The preferred temperature of the feeding larva of *Stomoxys* ranges between 15-30 °C and that of the prepupating (15-25 °C.) while that of *M. sorbens* ranges between 16-29 °C. for the feeding larva and 16-25 °C. for the prepupating larva. On the other hand, the thermopreferendum of *M. domestica* ranges between 25-33 °C. (feeding larva) and 8-25 °C. (prepupating larva). Thus in the case of *Stomoxys* and *sorbens,* both feeding and prepupating larvae, each coincided in their lower limit of thermopreferendum, while that of the prepupating larva of *M. domestica* is markedly lower than that of the feeding stage.

(4) Prior to pupation, larvae of *domestica* and *sorbens* have a similar habit ; in the former species, they migrate to the edge of the

dung heap or the surrounding earth seeking dried and cooler medium, while in the latter, they migrate below the stool seeking the dried air underneath. In *Stomoxys,* on the other hand, larvae do not migrate but they pupate in the same medium of the feeding larva and under the same conditions.

(5) There are three types of orientation mechanisms, namely, orthokinesis, klinokinesis and klinotaxis, which are involved in the reactions of *M. domestica* and *M. sorbens* larvae. In *Stomoxys,* in addition to the previous types, there is what looks to be another type of orientation (phototaxis), which involves movement by retrogression.

VII.   SUMMARY

The reaction of the feeding and the prepupating larva of *S. calcitrans* to several environmental factors : humidity, temperature and smell, were studied under laboratory conditions in an arena divided into two equal halves.

HUMIDITY REACTIONS : the feeding larva preferred humidities near saturation. It was indifferent or less sensitive to humidities below 50% R.H. The intensity of the reaction increased at the higher humidity ranges. The prepupating larva preferred humidities within the range 75-83% R.H., and unlike *Musca domestica* or *sorbens* it did not lose the response at the upper humidity range. Both larvae showed no adaptation to the humidity to which they had been previously exposed.

TEMPERATURE REACTIONS : the larva showed the first avoiding reaction to the higher temperature when offered 30 or 31 °C., in 100% R.H. When the larva was in direct contact with water, it was indifferent to greater temperature differences and very slight avoidance of the higher temperature began when the larva was offered 25 or 34 °C. The feeding larva has a preferred temperature range, which lies between 15-30 °C. The sensitivity of the larva to temperatures increases above 35 °C. and decreases below 15 °C. Temperatures above 31 °C. and below 8 °C. are avoided but the avoidance being stronger in the former case. The prepupating larva has a range of thermopreferendum which lies between 15-25 °C. Both larvae showed no adaptation to temperature to which they had been previously exposed.

SMELL REACTIONS : horse dung, ammonia, trimethylamine and acetone scented sides were preferred to the neutral side of the arena and the larva was repelled by the smell of propionic, butyric, formic and acetic acids. The prepupating larva seemed to have a weaker sense

of smell as indicated to its indifference to the smell of acetic acid and the neutral side of the arena.

The orientation mechanisms contributing to the behaviour of the larva towards such environmental factors seem to be orthokinesis, klinokinesis, klinotaxis asd phobo-taxis.

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LABORATORY EVALUATIONS
OF VARIOUS ACARICIDES FOR THE CONTROL
OF ADULTS AND EGGS OF SPIDER MITES

(with 2 Text-Figures and 1 Table)

by M. R. ABO EL-GHAR, Ph.D.,

Plant Protection Department, Faculty of Agriculture,
Ain Shams University.

The common red spider, *Tetranychus bimaculatus* Harvey, is a pest which causes losses to almost all types of crops and plants, e.g. cotton, certain truck crops, various ornamental plants and certain fruit crops. Recently, it has come into increased importance on account of the use of chlorinated hydrocarbons, since these insecticides apparently favour mites abundance by repressing its natural enemies.

Sulphur and its compounds have long been used to give excellent control. They have been applied extensively and effectively in controlling this pest. Many new acaricides and insecticides have appeared on the market in the past few years and it seems important to compare the effectiveness of these new materials on this pest.

While the literature is full of the effectiveness of acaricides on the adults of spider mites, little information is available on the action of acaricides on eggs. However, it is often supposed that the eggs are the most resistant stage (ABO EL-GHAR et al, 1958). HINTZ (1953) found that eggs of the European red mite were the most difficult stage to kill. He concluded that the average dosages of the organic insecticides did not prevent development of the eggs, but they often kill the larvae before they could rupture the egg shell. PETTY (1948) found that HETP used as a spray was not effective in killing the eggs of *T. bimaculatus*.

In view of these facts, nine acaricides were tested in the laboratory for the control of adults and eggs of *T. bimaculatus*.

METHODS AND MATERIALS

For these tests large colonies of non-resistant strains of *T. bimaculatus* were maintained on cotton plants. Since the plants were soon destroyed by the mites, it was necessary to have a constant supply of new cultures available at all times.

(1) TESTS WITH ADULTS : The treatments were made by immersing mite infested leaves in a series of known concentrations of emulsified toxicants tested. In preparation for such treatments, the plants were infested by pinning mite-infested leaves from the mite culture onto the young plants. Ten to twelve hours were allowed for the mites to transfer to new plants. Thenafter, the leaves which had been pinned were removed. Usually, 50-75 adult female mites succeeded to migrate to each leaf. Actually all stages could also transfer to the plants to be treated, but for the purpose of these investigations, only adult females were considered. These newly infested leaves were gently immersed in the test solution for 5 seconds and allowed then to dry. The treated leaves were placed on wet cotton covered with a filter paper in Petri dishes. This kept the leaves fresh for 7-10 days and served also to keep mites confined to the leaves. Counts were recorded after a period of 48 hours. Mites showing little or no movement of the legs were considered dead. Insecticides with prolonged residual toxicity may of course still affect mites not already killed after 48 hours, but as survivors at this stage appeared to be perfectly healthy it was evident that the insecticides tested would no longer have any effect. Each treatment was replicated four times for each dosage. Untreated checks were used in each test.

(2) TESTS WITH EGGS : Detached green cotton leaves were placed on wet cotton in Petri dishes. The leaves were so arranged that the under surface faced upwards. Ten adult females were placed on the lower surface of the required number of leaves, and the following day, having laid a sufficient number of eggs (60-80 per leaf), they were crushed. The leaves with the eggs were treated in the same manner as in adult tests. Counts were made 6 days after treatment. By that time, the dead eggs could be distinguished by their decolouration and many of the surviving eggs had hatched. Four replications for each dosage were maintained and untreated checks were used.

Treated leaves were kept in a well ventilated room under uncontrolled conditions.

(3) ACARICIDES TESTED : All acaricides were used as emulsifiable concentrates. The following list gives the common and chemical names of acaricides tested in these experiments :

Thimet 44-D : O, O diethyl S-(ethyl thiomethyl phosphoro-diothioate).

Systox : O, O diethyl S-(ethyl-mercapto ethanol thiophosphate).

Metasystox : a mixture of methyl-P=S=Systox (1) and methyl P=O=Systox (2).

Delnav : 2,3-p-dioxane dithio-bis-(O, O diethyl phosphoro-diothioate).

Gusathion : Benzotriazene derivative of dithiophosphoric dimethyl ester.

Demicron : 2-chloro-2-diethyl carbomoyl-1-methylvenyldimethyl phosphate.

Folidol E605 : Dimethyl paranitrophenyl thiophosphate.

Malathion : O, O dimethyl dithiophosphate of diethyl mercapto succinate.

Ekatin : $(CH_3O)_2PSSC_2H_4SO\text{-}C_2H_5)$.

RESULTS AND DISCUSSION

The dosage mortality regressions presented in this paper were based on experiments in which all acaricides were tested in a single day work. Therefore, a number of preliminary range-finding experiments were made to ascertain the approximate dosage range for each acaricide. The dosage mortality regression lines were based on at least 4 points. Table I presents the LD50's for all acaricides tested on both adults and eggs. In this Table, the test for significance was measured by the standard error based on the calculation of the fiducial limits from the dosage mortality relationships according to the method of BLISS (1938). This Table also shows the ratios of the LD50's for the eggs to those of adults. The dosage mortality regressions are shown in Figures 1 and 2 indicating the toxicity of acaricides tested to adults and eggs.

Data in Figure 1 and Table I show clearly a comparative effectiveness of acaricides tested on adults of spider mite in question. It is evident that Thimet 44-D excells all the rest of acaricides used in

<center>TABLE I.</center>

LD50's for adults and eggs of the two-spotted spider mite.

Acaricides	LD50's (G/100 ml.)		Ratio of the LD50's $\dfrac{\text{Eggs}}{\text{Adults}}$
	Adults	Eggs	
Thimet 44-D	0.0007 $+$ 0.0002	0.1100 $+$ 0.0410	157.0
Folidol	0.0010 $+$ 0.0005	0.0035 $+$ 0.0001	3.5
Gusathion	0.0014 $+$ 0.0004	0.0530 $+$ 0.0149	38.0
Delnav	0.0022 $+$ 0.0007	0.0089 $+$ 0.0034	4.0
Systox	0.0050 $+$ 0.0019	0.2600 $+$ 0.1000	52.0
Melathion	0.0063 $+$ 0.0002	0.3500 $+$ 0.1440	55.0
Demicron	0.0100 $+$ 0.0043	0.5300 $+$ 0.1800	53.0
Metasystox	0.0240 $+$ 0.0049	0.5160 $+$ 0.0245	21.0
Ekatin	0.0500 $+$ 0.0100	0.6200 $+$ 0.2200	12.0
Average			43.9

being the most effective on adults. However, the test of significance did not show any significant difference between it and Folidol in their toxicity to adults. It is also clear that Ekatin gives an inferior kill
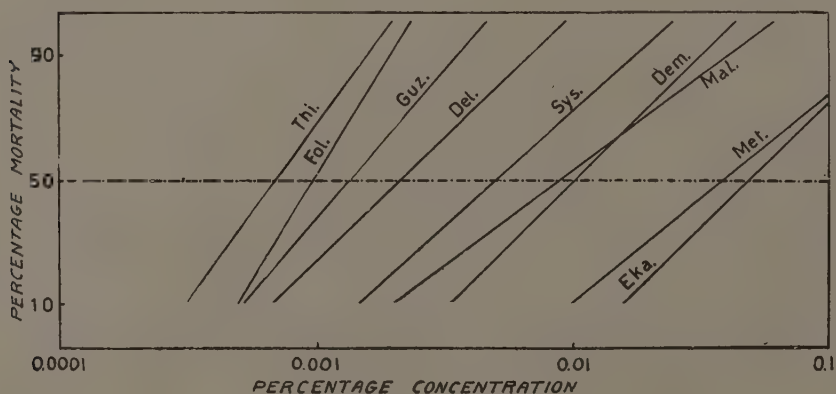
FIG. 1: Comparative toxicity of acaricides indicated against adults of *T. bimaculatus* (Del., Delnav; Dem., Demicron; Eka., Ekatin; Fol., Folidol; Guz., Gusathion; Mal., Malathion; Met., Metasystox; Sys., Systox; Thi., Thimet).

and the rest of acaricides tested proved to have an intermediate toxicity between Thimet and Ekatin. There was no significant difference between the toxicities of Folidol, Gusathion and Delnav. · Statistically, Systox, Malathion and Demicron, had shown to be equally effective.

The final picture for the effectiveness of acaricides tested on adults can be arranged in order of magnitude according to their toxicities as follows : Ekatin, Metasystox, Demicron, Malathion, Systox, Gusathion, Delnav, Folidol, Thimet.

Data of toxicity of acaricides tested on eggs are presented in Table I and Fig. 2. Eggs have shown to be the most resistant stage to all acaricides tested. Folidol was the most toxic compound to eggs followed by Delnav, Gusathion and Thimet. Although the rest of the materials had differently acted on eggs, yet they showed no significant difference in their toxicity. The toxicity rank of acaricides
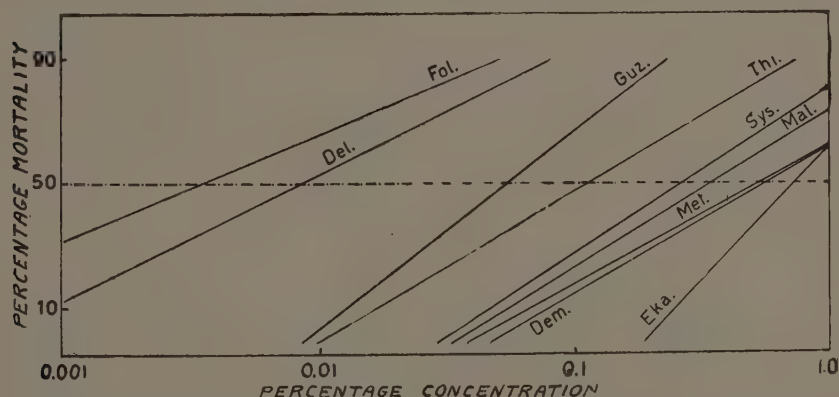
FIG. 2: Comparative toxicity of acaricides indicated against eggs of *T. bimaculatus* (Del., Delnav; Dem., Demicron; Eka., Ekatin; Fol., Folidol; Guz., Gusathion; Mal., Malathion; Met., Metasystox; Sys., Systox; Thi., Thimet).

tested against eggs are arranged in an increasing order as follows : Ekatin, Demicron, Metasystox, Malathion, Systox, Thimet, Gusathion, Delnav, Folidol.

On the basis of these results, one can arrange the acaricides tested according to their effectiveness against both adults and eggs as follows : Ekatin, Demicron, Metasystox, Malathion, Systox, Thimet, Gusathion, Delnav, Folidol.

The ratio of the LD50's for eggs as compared to adults is presented in Table I. It clearly shows that the ratio is particularly high

with Thimet. This is partially due to the extremely low concentration required to kill the adults. Accordingly, it could be concluded that the lower the ratio, the closer the toxicity of the compound to eggs and adults.

SUMMARY AND CONCLUSION

The LD50's were determined for acaricides used as emulsifiable concentrates against the two-spotted spider mite on cotton leaves. The comparative susceptibility of adults and eggs were studied. Eggs were by far, the most resistant stage to all acaricides used. They required on the average 43.9 times as much toxicant as used with adults to give a 5% kill. The LD50's for adults tested with Thimet and Folidol were lower than those treated with Ekatin. The rest of the compounds had an intermediate toxicity. On the other hand, Folidol was very toxic to eggs compared with the rest of materials. Systox gave an inferior kill to eggs.

In general, Folidol, Delnav and Gusathion seemed to be the most effective compounds against both adults and eggs.

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LIFE-HISTORY OF THE PREDATOR MITE,
Agistemus fleschneri SUMMERS,
AND EFFECT OF NUTRITION ON ITS BIOLOGY

[Acarina : Stigmaeidae]

(with 5 Tables)

by M. A. ZAHER, PH.D. (Lond), F.R.E.S.,
Plant Protection Department, Faculty of Agriculture, Cairo University

and E. A. EL-BADRY, M.SC.,
Entomology Department, National Research Centre of Egypt.

INTRODUCTION

Mites of the family Stigmaeidae Oudemans are world wide in distribution. They are frequently found on vegetation associated with infestation of injurious mites, although some are to be found in moss, lichens, straw and leaf debris.

Only few species, of which however, have been reported in the literature as predators of economic importance on some phytophagous mites. In 1946, NESBITT observed *Mediolata nova-scotiae* Nesbitt preying on eggs of *Bryobia praetiosa* Koch on apple trees while LORD (1949) reported the importance of this predator in checking population of clover mite. Also the mites *Mediolata terminalus* (Quayle), *Eupalopsis pinicola* Oudemans and *Neophyllabius* sp. were reported by BAKER and WHARTON (1952) to attack citrus bud mite, apple mites and crawler stages of scale insects, respectively. PARENT and LE ROUX (1956) stated that *Mediolata mali* Ewing devoured the apple tree mite *Metatetranychus ulmi.*

In Egypt, the only member of this family recorded by HASSAN et al (1959) as predator on Tetranychid mites injurious to cotton was

wrongly identified as *Mediolata* spec. This appeared in the survey conducted by the authors on red spider mites and their predators, when this mite has been identified and described by SUMMERS (1960) as *Agistemus fleschneri* n. gen. and n. sp. It was observed associated with colonies of Tetranychids and Tenuipalpids on leaves and twigs. Therefore, biological studies of this predator were found necessary to be carried out in the laboratory.

MATERIAL AND METHODS

Eggs and larvae of the two-spotted mite *Tetranychus cinnabarinus* (Bois.) were used as prey. This species was selected because of its wide distribution and economic importance. Green cuttings of sweet potatoe were put in test tubes filled with HOAGLAND solution which was changed twice a week to keep plants healthy for about two weeks (HOAGLAND and ARNEN, 1950).

Some predator females, collected from the field, were left together with some two-spotted mites on leaves to deposit eggs. Newly mated predator females resulting from this generation were placed on leaves for oviposition. After one day these females were picked up and eggs left to hatch.

In the experiment which was conducted to investigate the number of eggs consumed by the predator during its life-history, sixty cuttings of sweet potatoe with one leaf each were used. Two circles of Canada balsam and castor and citronella oils were made on the upper surface of every leaf for confining the individual mite and its preys. Three to five adult females of the prey were confined to one of the two circles and left to lay eggs. After about 12 hours these adults were transferred to the second circle of the same leaf to complete ovipositing while the newly hatched experimented predator larvae were placed singly in the first circles together with prey eggs. Transferring the prey adults and predator larvae to the other circles and counting eggs consumed by these individuals were done twice daily, in the early morning and just before sunset, during all the predator life-cycle.

Sixty other green cuttings of sweet potatoe were prepared with one circle only per leaf of the mentioned media. Sixty newly hatched predator larvae were confined singly to these circles, and these predators were supplied with prey larvae twice a day during the experiment.

BEHAVIOUR AND FEEDING HABITS

Agistemus fleschneri was observed on leaves and twigs associated with colonies of mites of families Tetranychidae and Tenuipalpidae. It is usually located on both surfaces of the leaves beside junctions of veins. Sometimes it occurs where infestation of soft scale insects are found on the ornamental plant *Lantana camara*.

In the laboratory mite activity is reduced by confinement. However, in nature, males are more active than females which normally move rather slowly unless being disturbed. In the latter case they crawl rapidly.

For food, it is noticed that this mite prefers to attack eggs, quiescent stages and moving immature stages of the two-spotted mite successively. Rarely this predator feeds on adults unless the previous mentioned stages have not been available. Even though, experiments showed that this mite wait till the prey female deposited eggs on which it fed. It usually grips the prey by its legs and palps, then it inserts the chelicerae in the dorsal region and suck the body contents.

It is also found that when the number of eggs are numerous the predator attacks as many as it could without completing sucking all the contents. Another point of interest that this species is not a plant feeder as will be mentioned later. Accordingly this behaviour gives the species an economic importance as predator. On the other hand it was noticed, in few cases, that it did attack its own eggs and immature stages.

During the course of this investigation, this predator fed on *Tetranychus cinnabarinus* (Bois.), *Eutetranychus banksi* McG., *Oligonychus terminalis* Sayed, *Brevipalpus* spp. and scale insects.

LIFE-HISTORY

Females deposit their eggs singly on the two leaf surfaces. The newly hatched six-legged larvae feed for a short time, differs, according to nutrition, and then enter the first quiescent stage from which the first eight-legged proto-nymphs emerge. These nymphs are more active, and when become full-grown they go through the second quiescent stage after which they change to deuto-nymphs. Finally, the deuto-nymphs enter the third quiescent stage and the adults emerge. In this species, male as well as female undergoes three active and three resting periods.

BIOLOGICAL ASPECTS

Mating

The male has the ability to copulate several times throughout its whole life. In the mating process, the male shows more activity by running about and rapidly moving its legs. It then approaches the female from behind and crawls under it, while the latter lifting its abdomen and spreads its legs widely. The male curves the end of its abdomen both uwards and forwards till it meets the tip of the female abdomen. The process of mating lasts about three minutes.

The female accepts to copulate more than once while unmated females do not accept any copulation three days after emergence. Parthenogenesis always occurs and only males emerge from unfertilized eggs.

Oviposition

The female deposits eggs on both surfaces of the leaves. Having a characteristic pattern during egg laying, it bends the posterior end of its abdomen up and down till the egg is attached to the top of plant hairs. Afterwards it withdraws the abdomen slowly leaving the eggs on the leaf hairs, where they are attached to the surface by means of an adhesive substance.

During the course of this experiment, i.e. May, June and July with the daily mean temperature 72-76 °F., the incubation period of *Agistemus fleschneri* averaged five days. No information, however, were taken during other times of the year.

Hatching

The newly deposited eggs are light yellow and round in shape. Before hatching the carmine eyes appear through the chorion. Then one side of the egg shell becomes dark yellow, where the embryo is seen lying inside. A slit is formed in that side from which the larva, at about the same size of egg, crawls out leaving a very thin transparent shell.

Moulting

Before moulting, the larva or the nymph enters into a quiescent stage during which it stops feeding and moving. The two front pairs of legs extend parallel to each other with the rostrum stretched for-

wardly while the hind pairs of legs extend posteriorly along the sides of the body.

The quiescence usually takes place near or beside veins of the leaves. Before moulting the skin glimmers like a mirror. It splits at a median transverse line which separates the propodosoma from the metapodosoma. The mite then tries to withdraw its forelegs and anterior portion of the body by twisting and wrinkling movements. After that it crawls forwards trying to get rid of the posterior part of the exuvia.

However, during this experiment which took place in summer, resting stage of either larva or nymph lasted for half to one day.

NUTRITIONAL EXPERIMENTS

An experiment was carried out to show the effect of plant nourishment on the survival of the predator. Twenty newly hatched larvae of *Agistemus fleschneri* were confined singly, with no prey on sweet potato leaves and left to complete their life-cycle. By examining the mites after two days it was found that all of them failed to survive. As they were observed apparently probing the leaf tissues it was then obvious that nourishment obtained from the plant cells was insufficient for the larvae to develop to proto-nymphs.

Other experiments were undertaken to investigate the number of eggs and larvae of the two-spotted spider mite consumed by the predator during its life-span and the effect of the different diets on its biology.

A.   Number of eggs consumed

Sixty newly hatched predator larvae were experimented according to the method mentioned before. Only 20 females and 15 males completed their life-cycle. Results showed that the mean number of eggs attacked by female during its life-span was significantly greater than that consumed by male (Table I). The maximum number was 665 eggs for female and 181 for male. Statistical analysis proved significant differences between the number of eggs consumed by different stages of predator female and male except during the larval stage.

The maximum number of eggs fed per day by immature and adult stages of the predator were 16 and 34 for female and 11 and 23 for male, respectively. However the most amount of food consumed by this mite was during its adult stage.

Number of prey larvae attacked by the predator during its life-cycle

Sex	Average number of eggs consumed by predator during					
	Larval stage	Proto-nymphal stage	Deuto-nymphal stage	Immature stages	Adult stage	Life span
Female	4.9	6.6	16.2	27.7	402.9	430.6
Male	4.3	4.4	10.2	18.9	118.8	137.7

From Table II it could be noticed that there was no difference between the number of eggs attacked during day and night.

TABLE II

Number of prey eggs consumed by adult predator during day and night.

Time	Average numbers of eggs consumed per predator during 15 successive days and nights															Mean
Day	8.8	6.3	9.7	5.9	5.9	5.4	7.8	6.5	5.7	3.8	6.0	6.1	2.8	5.7	4.3	6.5
Night	5.8	7.9	8.3	4.7	6.5	7.0	6.7	5.5	4.7	6.2	5.9	6.3	6.1	5.0	4.1	6.5

Counts are average of 20 females.

B. Number of larvae consumed

From sixty larvae of the predator mite used at the beginning of the experiment, only 24 females and 16 males completed their life-cycle. As mentioned in the previous experiments, female also consumed significantly large number of larvae than male. In average the former attacked 149.8 larvae during its life-span with a maximum of 195, while the male preyed on 47.2 with a maximum of 68 larvae. The average numbers of prey larvae fed by the predator during the immature stages of female and male were respectively 3.4 and 2.7 for larva, 3.9 and 4.1 for proto-nymph, and 6.5 and 4.2 for deuto-nymph.

Naturally, the adult was the most important stage in predation. During this stage it required larger number of prey larvae than all the immature stages (Table III).

TABLE III

Number of prey larvae attacked by the predator during its life-cycle

Sex	Average number of larvae attacked by predator during					
	Larval stage	Proto-nymphal stage	Deuto-nymphal stage	Immature stages	Adult stage	Life span
Female	3.4	3.9	6.5	13.8	136.0	149.8
Male	2.7	4.1	4.2	11.0	36.2	47.2

C.   Effect of nutrition on biology

1.   *Duration of immature stages*

The duration of active and quiescent immature stages were gen-
erally longer in the case of individuals fed on larvae than those fed
on eggs (Table IV).   This phenomenon occurred in both sexes.   How-
ever, by adding these periods together, it was found that it averaged
for 5.5 days for female and 5.3 days for male when fed on eggs, while
it prolonged to 7.2 and 6.3 days when fed on larvae.   These differences
between the two groups were statistically significant in both sexes.
The larva was the only stage which gave a conspicuous difference.

TABLE IV

Duration of different stages of predator fed on prey eggs and larvae

Type of food	Sex	Average duration of different stages in days							
		Active larva	Quiescent larva	Active photonymph	Quiescent photonymph	Active deutonymph	Quiescent deutonymph	Immature stages	Adult
Eggs	Female	1.1	0.6	1.1	0.5	1.7	0.5	5.5	31.3
Larvae		2.3	0.5	1.4	0.5	1.9	0.6	7.2	20.0
Eggs	Male	0.9	0.6	1.1	0.5	1.7	0.5	5.3	23.6
Larvae		1.7	0.5	1.4	0.5	1.7	0.5	6.3	12.6

It could be mentioned here that the male generally developed a little faster than the female (Table IV).

2. *Longevity*

Table IV showed that longevity was significantly affected by nutrition. It was much longer in the case of mites reared on eggs than that bred on larvae. The average durations of this period were 31.3 and 23.6 days for females and males of the former group and 20 and 12.6 days for the latter. In both groups adult females lived for longer periods than males.

3. *Pre-oviposition and oviposition period and number*
of deposited eggs

Usually a period elapses between the emergence of adult female and oviposition. This pre-oviposition period ranged from about 0.5 to 3.5 days with an average of 1.4 days when mites reared on eggs, while in mites bred on larvae it ranged from 1.5 to 3 days with a mean of 1.9 days.

Also oviposition period varied according to nutrition. It was longer in mites reared on eggs than in those reared on larvae. The mean period was 29.7 days, with a range from 20 to 43, for the former and was 16.5 days with a range from 11 to 21 for the latter. However female ceased laying eggs for about 1 to 2 days before mortality.

Results of oviposition also showed a significant difference between the mean number of eggs laid per female of the two experimental groups. Females which reared on eggs produced an average of 58.7 eggs while those reared on larvae laid an average of 28.3 eggs. In

TABLE V

Effect of day and night on the average number of eggs
laid by the predator female

A. Females reared on eggs.

Time	Average numbers of eggs laid per female during 10 successive days and nights*										Mean
Day	1.0	1.0	0.6	0.6	0.7	0.6	0.7	0.8	0.6	0.5	0.7
Night	1.5	1.6	1.7	1.4	1.4	1.5	1.4	0.9	0.9	0.9	1.3

* Averages for 20 females

B. Females reared on larvae

Time	Average numbers of eggs laid per female during 10 successive days and nights*										Mean
Day	0.3	1.0	1.0	0.6	0.6	0.7	0.6	0.7	0.8	0.5	0.7
Night	0.6	1.5	1.5	1.7	1.3	1.4	1.5	1.3	0.9	0.9	1.3

*   Averages for 24 females

both cases significant differences also occurred between number of eggs deposited during day and night, the number laid at night being larger (Table V A and B).

DISCUSSION

Experiments showed that the predator mite in its larval, nymphal and adult stages usually feeds on both eggs and immature stages of the prey. However, during life-cycle, the adult stage proved to be the more efficient as it consumed the majority of food offered. This might be due to the larger size of the adult and its longevity which amounted from 3 to 8 times the duration of the feeding immature stages. Also females consumed more food than males because of their large size and longer life-span.

Observation indicated that this mite, especially its immature stages, preferred to attack eggs of the prey. This is reasonable to believe as eggs are easy to manipulate by the predator rather than active larvae, nymphs or adults which are usually of similar size of the predator.

With regard to the effect of diet on development and egg production, it was found that individuals, reared on eggs developed faster and their adults lived longer than those fed on larvae. Also females of the former case oviposited twice the number of eggs produced by the latter. This might have resulted from quantity and quality of food consumld. Individuals bred on eggs attacked an average number 3 times that of the larvae. In this respect, HERBERT (1956) found that the mite *Typhlodromus tilia* Oudemans when fed daily on 40 eggs of *Tetranychus bimaculatus* Harvey developed in a shorter time and female laid more eggs than that fed on 20 eggs per day. In the meantime, although a larva might appear larger than an egg, most of the

.egg contents are consumed by the predator, while the liquid part of the larva which includes the haemolymph is the only part ingested. In addition the egg contents are of higher nutritional value when compared with the available watery part of the larva.

The present study however leads to the question of significance of the results obtained on the economic importance of this predator. As all larvae failed to survive if not supplied with animal nourishment, individuals might be induced to search for the prey. Also because of its wide range of prey species such as Tetranychids and Teniupalpids and its capability to consume large numbers of eggs and larvae this predator might prove success in checking infestation of phytophagous mites in the field.

SUMMARY

Laboratory studies were made on the biology of the predator mite *Agistemus fleschneri* Summers. Individuals were offered eggs or larvae of the two-spotted spider mite *Tetranychus cinnabarinus* (Bois.), confined on leaves of sweet popato cuttings. Observations included hatching, moulting, feeding habits and oviposition. Experiments also indicated the following results :

(1) During the predator whole life, number of eggs or larvae attacked by female exceeded that attacked by male. The former preyed on an average number of 430.6 eggs or 149.8 larvae while the latter consumed a mean number of 137.7 eggs or 47.2 larvae.

(2) The adult stage devoured the majority of eggs or larvae consumed during individual life-span.

(3) Larvae failed to survive when confined to leaves with no prey.

(4) Both females and males, fed on eggs, developed more rapidly than those fed on larvae. Also females of the former case lived longer and laid more eggs than those of the latter.

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PHYSIOLOGICAL STUDIES ON THE EFFECT
OF CERTAIN ORGANO-PHOSPHOROUS SYSTEMICS
ON COTTON PLANT

(with 5 Tables)

by Drs. M. S. EL-RAFIE and E. EL-HENNAWI,

Faculty of Agriculture, Ain Shams University.

INTRODUCTION

Several workers have reported their success in controlling suctorial insects and red spiders by using systemic insecticides. The literature since 1950 is full of such reports. The aim of the research was almost considering the determination of toxicity and the lasting effect of new systemics introduced in this field. RIPPER et al (1950), IVY et al (1950), REYNOLDS et al (1953), DAVID and GRINDER (1955), and a few others have shown that systemics are absorbed into seeds in sufficient quantities to give insecticidal action. Although most workers agree on the insecticidal effect of these systemics, contradictory results have been observed concerning its influence on plant growth and development.

VERMA (1956) applied Demeton and Schradan on maize seeds. He reported that all treated seeds gave rise to plants which grew approximately at the same rate. However, he also noticed phytotoxic symptoms in the form of banded chlorosis appearing on plants developed from seeds soaked in higher concentrations.

HOPKINS (1958) studied the effect of seed treatments of cotton with Thimet and Bayer 19639, and stated that Thimet adversely affected stands.

HANNA (1958) studied the effect of seed treatment of cotton with a number of systemics (i.e. Demeton, Ammonium cyanamide 12008 and 12009, Thimet and Bayer 19639). He stated that these materials varied in phytotoxicity which was manifested by reduced emergence or somewhat delayed fruiting. No significant reduction in yield resulted from these phytotoxic effects.

DOBSON (1958) tested Thimet and Bayer 19639, as seed treatments on two varieties of cotton. He reported that both materials reduced seedling stands, while the Thimet retarded blossoming and reduced growth during the early part of the season. But neither variety of cotton tested showed a decrease nor increase in yield at the end of the season.

HACSKAYLO (1957) studied the effect of Thimet on growth and nitrogen and phosphorous levels of cotton plants. Cotton plants were grown to maturity in the green house. All treated plants initially wilted but recovered later. Slight to severe necrotic flecking of the leaves occurred and was correlated with levels of Thimet in the substrate. Moreover, final dry weights were slightly greater for plants grown on the lowest level of Thimet, but were lower with the higher concentrations as compared with the control. Reducing sugars, sucrose and starch accumulated in young plants treated with Thimet, while soluble and protein nitrogen decreased. Thimet tended to cause an increase in the oil content of embryos at the expense of protein formation.

LORD (1957) studied the estrase inhibition by organo-phosphorous residues, with some observations on possible effects on plant metabolism. He concluded that organo-phosphorous insecticides inhibit added cholinestrase and plant estrases. Further, some interference with plant metabolism was detected. This may or may not be associated with the phytotoxic action which may occur when plants are treated at higher concentrations.

Reviewing the literature, a lack of information concerning the effect of modern systemic insecticides on the growth and chemical composition of cotton plants was noticed. Such information is of a paramount importance before any recommendations concerning the practical use of these systemics could be forwarded. The present work was thus carried out to investigate some of the physiological effects of a number of systemic organo-phosphorous compounds on the cotton plant in the earlier stage. Such information might throw some light on the problem of phytotoxicity. Moreover, it could be an indication to the preferable levels of systemics for seed treatment which gives the maximum beneficial effect.

MATERIAL AND METHOD

The organo-phosphorous systemic insecticides used in this investigation are :

(1) Thimet : O,O-diethyl S-(ethylthiomethyl) phosphorodithioate.

(2) Systox : a mixture of O,O-diethyl S-ethyl-mercaptoethanol thiophosphate and its isomer, O,O-diethyl-O-ethyl-mercaptoethanol thiophosphate.

(3) Metasystox : a mixture of two isomers namely, methyl-P=S= Systox(1) and methyl-P=O-Systox(2).

(4) Isopestox : bis(monoisopropylamino) flurophosphine oxide.

(5) Ekatin : Thiometon, $(CH_3O)_2$ $PSSC_2H_4SO-C_2H_5$.

To avoid lethal levels of these insecticides, preliminary experiments on cotton seed germination were performed. On the light of those experiments two levels of each insecticide were chosen, a low level (i.e. 50 P.P.M.), and a high level (i.e. 150 P.P.M.).

Insecticides were applied to cotton seeds, of Ashmouni variety, by the soaking technique. Such a technique, besides being more convenient, the toxicant material is apparently taken up by the seeds more rapidly than by other techniques (REYNOLDS et al, 1957). Seeds were thus soaked for a definite period (3 hours) and at a controlled temperature (25 °C). Just before sowing, the seeds were dipped in fresh water to remove any insecticide adhering to the seed coat.

Sowing took place in sand culture. 100 seeds were taken at random from each treated lot and used for sowing. Pots of 15 kg. capacity were used. Each treatment contained 10 pots filled with acid-washed sand. 10 cotton seeds were grown in each pot at measured distances and one inch depth from sand surface.

To provide plants with all necessary nutrient salts, a complete nutrient solution of HOAGLAND and ARNON (1950) was chosen. The nutrient solution was applied every two days during the course of experiment (HEWITT and MILLES, 1950). Tap water was added when needed to maintain adequate moisture level. To avoid salt accumulation in the substrate, all pots were flushed with tap water every week.

Plants for analysis were selected at random from each treatment three times during the growing season. This lasted for three months from the date of sowing. The first, second and third samples for analysis were taken after 1, 2 and 3 months from the sowing date, successively. Data on the fresh and dry weights and height of plants were

recorded and the total nitrogen percentage in plants was determined. Samples were dried for three days in an electric oven thermostatically controlled at 80 °C. and were ground in a Wiley mill. The total nitrogen percentage was determined in the finely powdered dry material using the micro-Kjeldahl method (PIPER, 1947).

Data obtained with the five systemics employed are manifested in Tables I-V. The results obtained from each material with the lowest and highest levels employed are given in each Table. For the uniformity of data and ease of comparison, results of each item were recalculated as a ratio to the control.

RESULTS AND DISCUSSION

1.   Effect of Thimet

Data obtained are shown in Table I. The first glance to these results shows clearly that Thimet had a general promoting influence on plants. The low concentration is apparently more effctive on the growth behaviour than the higher levels. Such a fact is highly pronounced in the first and particularly in the second month. Plants have shown much increase in the lengths of epicotyle compared with the third month aged plants. In the later, a slight retardation in growth was noticed. The ratio of lengths was 1.25 and 1.47 for the first and second months, respectively. It was only 0.95 for the third month. The fresh weights of plants behaved in almost a similar manner

TABLE I

Effect of Thimet on the growth of cotton

Concentration employed	Age of plants in months	Length of epicotyle	Fresh weight	Dry weight	Total percentage of nitrogen
50 p.p.m.	1	1.25	1.16	1.10	1.31
	2	1.47	1.57	1.75	0.82
	3	0.95	0.92	1.24	0.72
150 p.p.m.	1	1.21	0.92	0.85	1.35
	2	1.11	1.17	1.27	1.04
	3	0.95	1.11	1.00	0.85

When the dry weight was taken as a measure of growth, it could be clearly noticed that the lower concentration of Thimet favoured the accumulation of the dry materials in plants. Treated plants in the different stages of growth possessed higher values of dry matter compared with the control. The peak ratio was obtained, as well, in the second month (i.e. 1.75). These results may be related to a lower level of water in the tissue of the treated plants and the increase in dry matter during this growth phase. Such results agree with those obtained by HASCKAYLO (1957), who found that dry weights were higher when cotton plants were treated with the lower levels of Thimet.

Taking the percentage of total nitrogen as a criterion, it was found that it had a higher value in the earliest stage (i.e. one month) then decreased gradually when plants proceeded in growth. The ratios were 1.31, 0.82 and 0.72 after one, two and three months, respectively. This might be explained as being due to a relationship between the phosphorous and nitrogen contents in the tissues. The phosphorous content was naturally of a higher value in the first month, and thus a higher ratio of nirogen was obtained. Such results almost agree with those obtained by SIEDERIS and YOUNG (1946).

Plants treated with the higher concentration of the systemic insecticide, showed results which almost agree with those obtained with the lower level. Both applications caused a certain degree of stimulation to plant growth. However, the lower the concentration, the higher the apparent stimulant effect. Moreover, results indicate that increasing the concentration over the highest level employed (i.e. 150 p.p.m.) might cause a reduction in the growth and development of cotton plants.

2. Effect of Systox

Data obtained are shown in Table II. Results show clearly that both concentrations of this material caused a remarkable stimulation on the plant growth. With the lower concentration, the peak of lengths of plants was obtained on the first month, then a gradual decrease occurred by the lapse of time. However, the three months aged plants were still higher than the control. The ratios of lengths were 1.6, 1.47 and 1.16 for the first, second and third months, respectively. Almost similar results were obtained with the fresh weight measurements. Dry weight measurements gave also higher ratios than the control. The total nitrogen percentage gave a similar ratio to that obtained with Thimet, i.e. a higher ratio in the first month and a gradual decrease by the lapse of time.

TABLE II

Effect of Systox on the growth of cotton

Concentration employed	Age of plants in months	Length of epicotyle	Fresh weight	Dry weight	Total percentage of nitrogen
50 p.p.m.	1	1.60	1.40	1.31	1.31
	2	1.47	1.33	1.52	0.86
	3	1.16	0.98	1.44	0.66
150 p.p.m.	1	1.41	1.38	1.27	0.96
	2	1.82	1.90	2.14	0.78
	3	1.21	1.30	1.09	0.58

The higher level of Systox applied was apparently more effective on growth stimulation. The lengths of treated plants were remarkably promoted, especially on the second month. The ratios were 1.41, 1.82 and 1.21 for the first, second and third months, respectively. Similar results were obtained with the fresh and dry weight measurements. However, the percentage of total nitrogen was less than the control during the different stages of growth. Moreover, a gradual decrease was obtained by the lapse of time. The ratios were 0.96, 0.78 and 0.58 for the first, second and third months, respectively. This might be attributed to the utilization of nitrogen in building up certain complicated compounds, in which the nitrogen is apparently undetectable by the technique used.

Results obtained thus indicate that this insecticide apparently favours the growth and development of treated plants when applied in higher levels. Therefore, a higher concentration could be recommended with a double purpose. On the contrary, Thimet, as previously shown, favours groth when only applied in a lower level.

3. Effect of Metasystox

Results obtained are shown in Table III. It can be clearly noticed that lower levels of Metasystox could be more favourable to plant growth than higher levels. Moreover, the lower concentration gave almost results of a similar trend to those obtained with Systox. A remarkable increase in the lengths of plants was quoted on the first month, followed by a gradual decrease by the lapse of time. The ratios were 1.49, 1.26 and 0.98 for the first, second and third months, respectively. Measurements of fresh and dry weight and percentage of nitrogen behaved almost in a similar manner.

TABLE III

Effect of Metasystox on the growth of cotton

Concentration employed	Age of plants in months	Length of epicotyle	Fresh weight	Dry weight	Total percentage of nitrogen
50 p.p.m.	1	1.49	1.19	1.13	1.28
	2	1.26	1.13	1.20	0.80
	3	0.98	0.88	0.60	0.49
150 p.p.m.	1	1.32	1.01	1.00	1.12
	2	1.13	0.92	0.86	0.88
	3	0.88	0.58	0.98	0.58

Data obtained with the higher levels gave almost results of the same nature, but in lower rates. There was a certain degree of promotion in lengths of plants on the first and second months. Plants of three months old were almost under ratio. The ratios were 1.32, 1.13 and 0.88 for the first, second and third months, respectively. The depressing effect was more verified by fresh weight measurements. While the first month plants gave almost normal weight (i.e. 1.01), the second and third months weights showed a gradual and noticeable decrease. The ratios were 0.92 and 0.58, respectively. Measurements of total percentage of nitrogen gave almost similar results.

4.   Effect of Isopestox

Data obtained are shown in Table IV. Results demonstrate clearly the favourable influence of Isopestox on plant growth. Both levels employed caused a remarkable increment during the different stages of growth. However, the lower level apparently showed a slight more stimulant effect.

With the low concentration, the lengths and fresh and dry weights of plants were increased. The maximum difference between the treated plants and the control almost occurred in the first month. A gradual decrease took place in the second and third months. However, plants still showed a higher ratio in measurements than the control. Taking the ratios of lengths as example, they were 1.72, 1.29

TABLE IV

Effect of Isopestox on the growth of cotton.

Concentration employed	Age of plants in months	Length of epicotyle	Fresh weight	Dry weight	Total percentage of nitrogen
	1	1.72	1.36	1.24	1.08
50 p.p.m.	2	1.29	1.17	1.27	0.80
	3	1.16	1.09	1.01	0.72
	1	1.60	1.32	1.37	1.27
150 p.p.m.	2	1.44	1.35	1.45	0.80
	3	1.04	0.93	1.12	0.82

and 1.16 for the first, second and third months, respectively. The total nitrogen percentage ratio gave almost similar results to those obtained with other systemics tested. A higher ratio than the control was obtained for the first month, followed by a gradual decrease for the second and third months. The ratios were 1.08, 0.80 and 0.72, respectively.

The higher concentration showed almost similar results, which is generally of a slight lower value. However, the second month's measurements, for the lengths and fresh and dry weights, showed a slight increase than those obtained with the lower concentration. While with the lower concentration, the ratios of the above items were 1.29, 1.17 and 1.27, those with the higher concentration were 1.44, 1.35 and 1.45, respectively. Thus the lower concentration apparently promoted the growth in an earlier stage than the higher concentration.

5.   Effect of Ekatin

Data obtained are shown in Table V. Results are generally of the same nature as those obtained with other organo-phosphorous compounds tested. A general stimulant effect on growth was quoted with the two concentrations employed. The peak of increment was noticed on the first month, then followed by almost a gradual decrease by the lapse of time. However, on the third month, the lengths, fresh and dry weights of plants were generally higher than those of the control.

TABLE V

Effect of Ekatin on the growth of cotton

Concentration employed	Age of plants in months	Length of epicotyle	Fresh weight	Dry weight	Total percentage of nitrogen
50 p.p m.	1	1.45	1.51	1.34	1.17
	2	1.42	1.18	1.14	0.45
	3	1.11	0.95	1.21	0.47
150 p.p.m.	1	1.69	1.35	1.21	1.34
	2	1.29	1.04	1.23	0.90
	3	1.21	1.14	1.03	0.61

The higher concentration gave an apparent higher stimulant effect that the lower one. Such a fact was more pronounced on the lengths of plants. While with the higher levels the ratios were 1.69, 1.29 and 1.21, with the lower level the ratios were 1.45, 1.42 and 1.11 for the first, second and third months, respectively. The total nitrogen percentage measurements gave almost similar results. While with the higher levels the ratios were 1.34, 0.90 and 0.61, with the lower level the ratios were 1.17, 0.45 and 0.47 for the first, second and third months, respectively. However, fresh and dry weights measurements did not show a significant difference under both levels.

Such results indicate that practically higher concentrations of Ekatin could be safely applied to the seeds. A double purpose profit might thus be obtained, as a stimulant effect on the growth and development of plants could be expected.

SUMMARY AND CONCLUSIONS

The literature was reviewed. A lack of information concerning the effect of systemic insecticides on the growth and development of cotton plants were quoted. Five organo-phosphorous systemics were tested (i.e. Thimet, Systox, Metasystox, Isopestox and Ekatin). Application of insecticides was accomplished by a soaking technique. Two concentrations of each systemic were employed (the lower was 50 p.p.m. and the higher was 150 p.p.m.) treated seeds were cultivated

in pots filled with specially prepared sand culture. Plants were supplied with a complete nutrient solution of HOAGLAND and ARNON, throughout the course of experiment. Plants for analysis were taken at monthly intervals (i.e. after the first, second and third months from the date of sowing). Data on the lengths of plants, and fresh and dry weights were recorded. Moreover, the total nitrogen percentage was chemically determined. For the uniformity of data, all results are recalculated and tabulated as a ratio to the control.

Generally speaking, all the organo-phosphorous compounds tested caused an increment in plant growth. However, they varied in their influence from one material to the other. Moreover, different concentrations or levels of each systemic caused different stimulating effect.

Taking the lengths of epicotyle as a criterion, Isopestox gave the higher increment on the one month's aged seedling, when seeds were treated with the lowest concentration (i.e. the ratio was 1.72) this was followed by Systox, Metasystox, Ekatin and Thimet, respectively. However, when higher concentrations were employed, the above systemics could be arranged in the folowling descending order : Ekatin, Isopestox, Systox, Metasystox and Thimet, respectively.

A correlation between the phytotoxicity of these systemics and their stimulant affection plant growth could be forwarded. In a previous paper (in press) the author found that Thimet has shown to be the most injurious material. Isopestox and Ekatin did not show apparent signs of phytotoxicity. The same results were also observed on the study of these materials against spider mites.

The lower concentration (50 p.p.m.) was generally more favourable to the growth and development of cotton plants in the earlier stages. It was only with Ekatin and Systox that the higher concentration gave an apparent higher stimulant effect. It could thus be concluded, that lower levels of other systemics have to be recommended if a maximum increment in growth have to be considered. However, with Ekatin and Systox a higher level could be recommended if a double purpose profit have to be obtained.

The maximum stimulant effect was almost obtained on the one month's age seedings. There was comparatively a gradual decrease on the second and third months' age plants. However, treated plants were still, in general, higher than the control. This might be due to a rapid absorption and utilization of the organo-phosphorous systemics employed by the cotton plants. Thus the growth was remarkably promoted at the earliest growth phase. There is, thus, a great

correlation between the lasting toxic effect of systemics within plant tissues and their stimulant effect on plant growth. Plants are known to be toxic to insects within four to six weeks from treatment. As the material is utilized within the plant tissues there is a gradual decrease in the lengths of plants after the first month. It is believed that such a decrease in growth could be stopped by a second application with the systemic. This could be accomplished through the root systems. Thus, this root treatment could be of a double purpose profit.

Fresh weight measurements followed, in general, the same trend of the lengths measurements. The highest ratio was obtained, as well, on the first month, followed by almost a gradual decrease on the second and third months. However, dry weight measurements did not seem to follow always the same direction. In general, the organo-phosphorous systemics employed favoured the accumulation of dry materials in plants. In the different stages of growth, treated plants possessed higher value of dry matter compared with the control. This might be related to a lower level of water in the tissues during the growth phase.

Taking the percentage of total nitrogen as a criterion, treated plants possessed, in general, a higher value than the control on the first month. However, on the second and third months the ratios were lower than the control. Different degrees in reduction were obtained with the different materials and the different concentrations tested. As a rule, there is a correlation between the total nitrogen content in the plant and rate of growth. The higher the percentage of nitrogen the greater the rate of growth. However, a different phenomenon was quoted from the obtained results. While the ratio of growth in treated plants was generally higher than the control, the ratio of nitrogen content was generally lower than the control. This might be attributed to the utilization of nitrogen in building up certain complicated compounds in the treated plants. The nitrogen in such compounds is apparently undetectable by the technique employed.

The whole of the finding in this paper is thought to be new. The work has allowed certain practical recommendations. The authors believe that a succeeding investigation on the effect of these organo-phosphorous systemics on cotton plant is needed. The study of their effect on carbohydrates, mineral composition, enzyme activity in plants and the constituents of the oil content is of paramount importance before these insecticides could be practically recommended.

ACKNOWLEDGMENT

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A LEAF-MINER, Liriomyza bryoniae (Kalt.),
ATTACKING CUCURBITACEOUS PLANTS IN EGYPT

[Diptera : Agromyzidae]

(with 4 Text-Figures)

by Dr. SALAH ABUL-NASR, Ph.D. (Cantab.),
Faculty of Agriculture, Cairo University,
and MAHMOUD A.H. ASSEM, M.Sc.,
Plant Protection Department, Ministry of Agriculture, Dokki.

A leaf-miner attacking the leaves of cucurbitaceous crops was first discovered in the Southern Region of the United Arab Republic in the spring of 1958. Adult flies were reared from infested plants of the Egyptian melon *Cucumis melo* var. *aegyptiacus* and were identified by Mr. K.A. SPENCER of the British Museum (Natural History).

FIG. 1: *Liriomyza bryoniae* (Kalt.), adult fly. — FIG. 2: Same, larva. — FIG. 3: Same, pupa. — FIG. 4: Portion of a water-melon leaf showing nature of damage.

Liriomyza bryoniae (Kalt.) (Fig. 1) measures 1.6-1.8 mm. long, 0.2-0.8 mm. wide; wing expansion 10-11 mm. The head is yellow

brownish in front, except for the antennal setae which are black, back
of the head black, proboscis light yellow. The pronotum and meso-
notum are black, the metanotum and the sternal region are light yel-
low. Coxae and femora light yellow, rest of legs look black due to
thick covering of short black hairs. Wings transparent, with gray
silvery shade ; calypterae quite obvious ; halteres light yellow. Abdo-
men black except at the edges of tergites where a tinge of yellow
colour is evident.

Life-history

The fertilized female stings with its ovipositor the tissue of the
underside surface of the leaf and deposits a single egg at each sting.
During summer, the incubation period of the eggs takes from 3 to 4
days. The hatched larva (Fig. 2) start to make very fine tunnels
underneath the epidermis of the leaf and spends about a week before
reaching its full grown size which attains 2.4 mm. long and 0.5 mm.
broad. Then, it leaves the tunnel and drops down to the ground for
pupation. The puparium (Fig. 3) measures 1.8 × 0.9 mm. and is
usually found at 2 to 3 cms. below the ground surface in the area
around the plant hosts. The pupal stage takes 5 to 6 days after which
the emergence of the fly takes place.

Symptoms of damage

Cucurbit plants are subjected to infestation in the seedling stage.
The infested plants are identified by the presence of irregular tun-
nelling on the underneath surface of the leaves (Fig. 4). These tun-
nels are of silvery appearance at first, but later they become brownish.
Their end may be turned into a small blotch that may be enlarged as
a result of many maggots meeting at the same spot. Under a heavy
infestation, the affected leaves look dwindled, droopy and later may
become dry. The infested plants are relatively weaker than the
healthy plants, and the expected fruits are accordingly affected. The
seedlings and young plants are very sensitive to the attack and may
perish.

Distribution

Infested crops were observed at Ismailia (Suez region), Salhia
(Sharkia province), Dokki and Giza. In these regions, infestation is
usually expected during March, April and May and may cause great
damage to the water-melon and the Egyptian melon. Squash may be
also severely damaged in Giza region.

Methods of control

(1) Infested leaves or whole damaged plants should be collected and buried deeply to get rid of the enclosed larvae.

(2) In case of severe infestation, all crop residue should be gathered to be burned, and the soil to be turned over to expose the buried pupae.

(3) Primary experiments indicate the effectiveness of Endrin 19.5% against this insect. This insecticide was diluted to 0.4% and was sprayed on the plants 3 to 4 times at two weeks intervals, starting from the seedling stage, provided that spraying should be stopped before blooming.

ADDITIONAL RECORDS OF INSECT PESTS FROM LEBANON AND SYRIA

by A. S. TALHOUK,

Faculty of Agricultural Sciences, American University, Beirut.

Since the publication of the lists of pests of crops of Lebanon and Syria (TALHOUK, 1950, 1954), additional very useful information from Syria was published by SCHNEIDER (1957 a, b ; 1958). In order to make the information relative to this question as up to date as possible, this short addendum is written.

Some species are very serious in a locality, but do not exist in another. Or, if they do, they are not alarming. A very serious pest is marked thus***, a serious one**, and a pest which occasionally needs control by*. The name of a species not followed by an asterisk means that the species did not reach the level of a pest.

From LEBANON

On apple

Dictyophora n. sp. (det. W. WAGNER) (Homoptera Cicadidae) ; *Bryobia practiosa* Koch** and *Metatetranychus ulmi* (Koch)*** (Acarina Tetranychidae).

On pear

Hoplocampa brevis Klug* (Hymenoptera Tenthredinidae).

On cherry

Papilio podalirius L. and f. *virgatus* Butler (Lepidoptera Papilionidae) ; *Hoplocampa flava* L. (Hymenoptera Tenthredinidae).

On almonds and plums

Phytoptus phleocoptes typicus Nalepa*** (det. A.M. MASSEE) (Acarina Eriophyidae).

On grape vine

Retithrips syriacus Mayet* (Thysanoptera) ; *Polyphylla fullo* L.** (Coleoptera Scarabaeidae).

On citrus

Phyllocoptruta oleivora Ashm.*** (Acarina Eriophyidae) ; *Parlatoria pergrandii* Comst. (Homoptera Coccidae).

On olives

Prays oleellus F. (Lepidoptera Yponomeutidae).

On potato

*Gnorimoschema operculella*** (Z.) (Lepidoptera Gelechidae).

From SYRIA

On almonds and plums

Phytoptus phleocoptes typicus Nalepa** (Acarina Eriophyidae).

On citrus

Phyllocoptruta oleivora Ashm.** (Acarina Eriophyidae).

On cucurbitaceae

Epilachna chrysomelina F.*** (Coleoptera Coccinellidae).

On graminaceae

Psylloides sp.** (Coleoptera Halcitidae) ; *Aelia rostrata* Boh.*** (Hemiptera Pentatomidae).

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Asterolecanium phoenicis
INFESTING DATE PALM IN SAUDI ARABIA

[*Homoptera-Coccoidea*]

E.M.N.

by AHMED IBRAHIM EZZ

and ANWAR ABOU EL-EZZ,

Horticultural Insects Investigations Department,
Ministry of Agriculture (Dokki), Egypt.

Asterolecanium phoenicis Ramachandra Rao has been originally described from Iraq (Mesopotamia) in 1922. It is also recorded from Iran by BODENHEIMER (1944). In both of the fore-mentioned countries, it infests date palm (*Phoenix dactylifera*), mainly the leaf stalks, leaves and fruits. Its existence in Saudi Arabia was reported from Al-Karag by NIXON (1954).

Recently, while examining the collection of Coccid slides of the Ministry of Agriculture, we came across material entered into Egypt through the Quarantine Department and labelled "on date palm imported from Elhasa, Saudi Arabia, 6. vi. 1950".

This record establishes the existence of *Asterolecanium phoenicis* in Saudi Arabia prior to NIXON's statement. . On the other hand, as this pest does not occur in Egypt, careful steps should be taken concerning the importation of date palms from Saudi Arabia or other countries into our country.

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AUTORADIOGRAPHY AS A TECHNIQUE FOR RADIOACTIVE PHOSPHORUS, P-32, UPTAKE IN Culex molestus FORSK.

[*Diptera : Culicidae*]

(with 5 Text-Figures and 2 Tables)

by ALBERT A. ABDEL-MALEK,

Department of Entomology, Faculty of Science, Cairo University,

and MOHAMED F. ABDEL-WAHAB,

Radio-Isotope Center, Atomic Energy Establishment, U.A.R.

INTRODUCTION

Culex molestus Forsk. is known to be the vector of *Wucheraria bancrofti*, the parasite of Filariasis. The pronounced increase of incidence of this disease in certain areas of the Nile Delta in the southern region of the United Arab Republic, makes it quite essential to study the flight range, dispersal and migration of this culicine mosquito. For such study, tagging of the adult mosquitoes by radio-isotopes is greatly desired and of great value. Radiophosphorus, P-32, is selected for its convenient half life (14.3 days), availability, ease of handling and cheapness.

Laboratory-reared yellow fever mosquitoes, *Aedes aegypti,* were made highly radioactive by HASSETT and JENKINS (1949) by rearing third and fourth instar larvae and pupae in solutions of radioactive phosphorus in the form of basic sodium phosphate $Na_2HP^{32}O_4$. The same species was also marked at Lagos, Nigeria, by BUGHER and TAYLOR (1949) by rearing the immature stages in solutions of radioactive

phosphorus P-32 and strontium Sr-89. Also arctic pest mosquitoes *Aedes pullatus* and *Aedes excrucians* were made radioactive by JENKINS (1949) using P-32 in open pools.

In the above mentioned works on *Aedes* species, radioactivity was determined in all life stages of the mosquito, by using the counting technique. In such technique, a number of insects ranging from 5-12, were used in each count. However, the low sensitivity observed in the counting technique for uptake estimation of P-32 in the early larval instars especially when minute doses of the radioactive isotope were used, urged us to look for a more sensitive, simple, relatively inexpensive and reliable method for such an estimation.

In the present study, a simple autoradiographic technique has fulfilled the purpose. The apposition method as given by FITZGERALD (1953) proved to be of great value in the uptake estimation of radioactive phosphorus in the early larval instars of *Culex molestus*.

HISTORICAL

Apparently, the first application of autoradiography in biology was in 1904 when LONDON exposed a frog in a bottle to the emanations from radium, then placed the frog on photographic emulsion and obtained an image of the amphibian after processing the emulsion. The first autograph of artificial radio-isotopes was made by GROVEN in 1938 (BOYD 1955). Subsequent progress of autoradiography has been rapid, particularly with the development of nuclear track emulsions. FITZGERALD (1958) made a survey of the autoradiographic technique and its application in biology and medicine.

METHODS

Preparation of larval media

Fourteen different doses of radioactive phosphorus in the form of $Na_2HP^{32}O_4$ ranging between 0.05 and 10 microcuries per milliliter, were prepared. Fifty milliliters of each of these concentrations were made, into which was added 100 second stage *Culex molestus* larvae. To each of these media, a small pellet of guinea pig food of standard weight was added. Table I shows the concentration of radioactive phosphorus P-32 per mosquito larva in the 14 larval media used.

<center>TABLE I.</center>

Concentration of P-32 in the different larval media used in the experiment.

Beaker number	Dose of P-32 per milliliter in microcuries	Dose of P-32 per insect in microcuries
1	0.05	0.025
2	0.1	0.05
3	0.2	0.10
4	0.5	0.25
5	1.0	0.50
6	2.0	1.0
7	3.0	1.5
8	4.0	2.0
9	5.0	2.5
10	6.0	3.0
11	7.0	3.5
12	8.0	4.0
13	9.0	4.5
14	10.0	5.0

Another 100 *Culex molestus* larvae taken from the same stock were put in 50 milliliters of water together with a pellet of standard guinea pig food, but with no radioactive phosphorus added. This beaker was used as control.

At regular 24 hours intervals, one specimen from each of the 14 concentrations and the control, was taken out, at random, for the autoradiographic technique.

The experiment started on 14 January and lasted about two months.

Auto-radiographic technique

The specimens taken out from the 14 different P-32 concentrations and the control, were killed, each separately, by being immersed in hot water, then washed in three changes of fresh distilled water. A very fine camel-hair brush was used for the transfer of the specimens. The washed specimens were then dried on filter paper and transfered

to a protected dental film (3 × 4 cms. Gevaert Dentus Rapid) by means of a clean dry pointed forceps. The larvae were arranged on the non-shielded surface of the dental film. They were then covered with a piece of cellophane paper and a constant weight was applied over the larvae on the film. The larvae were left on the film for a period of one hour after which they were removed and the dental film processed.

The presence of a tin foil on one side of the dental film has the advantage of backscattering the beta rays emitted from the tagged insects placed over the non-shielded side of the film. Hence, the reaction of the beta rays with the film emulsion is intensified.

Processing of the dental films

The exposed dental films were placed inside a Kodak developer for 15 minutes at a constant temperature of 20 °C. The developed films were then inserted for 2 minutes in a stop solution of 2% acetic acid.
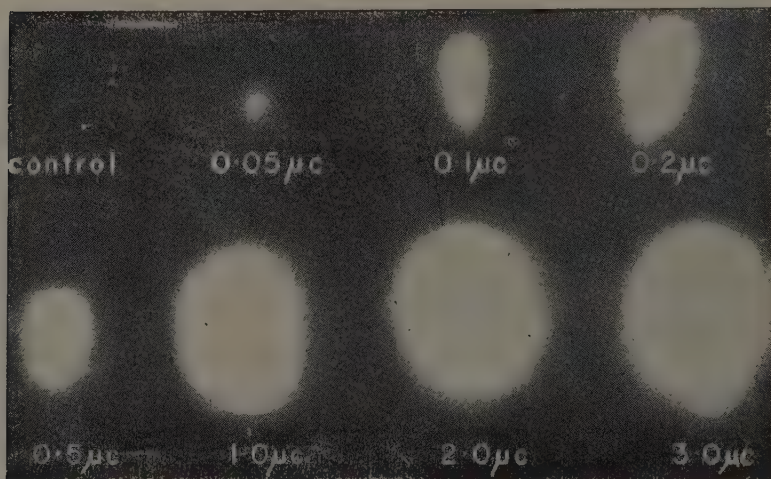
FIG. 1: Autoradiograph of 8 *Culex molestus* larvae bred in different P-32 concentrations in microcuries. The blank space of the upper left corner is that of the control.

Fixation was achieved by immersing the films in 30% solution of sodium hyposulphite. The films were then rinsed for 2 hours under

running tap water, after which they were hanged to dry in the dark room. The processed photographic emulsion is called the autoradiograph or autograph. Fig. 1 shows the autoradiograph of 8 *Culex molestus* larvae bread for 5 days in seven P-32 concentrations ranging from 0.05 to 3.0 microcuries per milliliter. The empty space on the upper left corner of the autoradiograph is that of the control.

Densitometry

The opacity produced by the interaction of the tagged insects with the film emulsion was measured by means of a densitometer (model No. 52 Photovolt Corporation N.Y.). The readings given in REPS were then transformed to microcuries by the help of a calibrated standard curve.
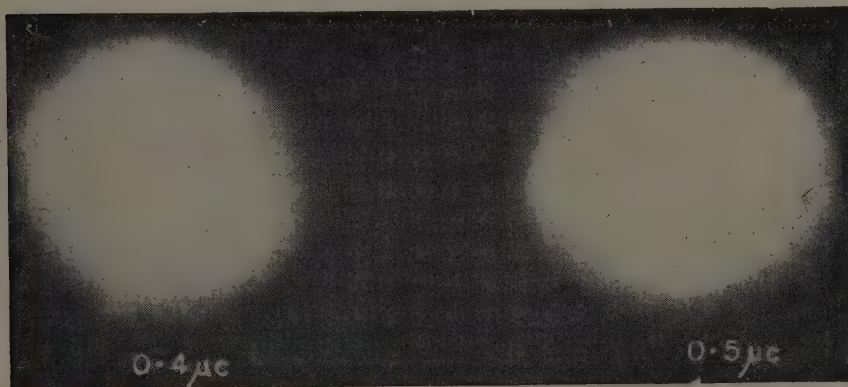
FIG. 2: Autoradiograph of a planchet with 2 dry-point sources having P-32 concentrations of 0.4 and 0.5 microcuries.

Calibration of the standard curve

Eight different concentrations of labelled basic sodium phosphate, $Na_2HP^{32}O_4$ ranging from 0.05 to 0.8 microcuries were prepared on planchets as dry-point sources. Two of these concentrations were nsed per planchet. A dental film was then placed over each planchet with its non-shielded surface towards the point standard sources. After one hour exposure, the films were removed, processed and the autoradiographs were then measured by means of the densitometer. Figure 2

shows the autoradiograph of a planchet with two dry point sources having P-32 concentrations of 0.4 and 0.5 microcuries. Table II gives the readings of the densitometer in REPS corresponding to the eight standard concentrations of P-32 used.

TABLE II.

Densitometric calibration of standard P-32 concentrations.

P-32 concentration in microcuries	Minimum density in REPS	Maximum density in REPS	Average density in REPS
0.05	0.38	0.42	0.40
0.10	0.50	0.54	0.52
0.20	0.85	0.90	0.88
0.30	1.34	1.38	1.36
0.40	1.63	1.65	1.64
0.50	2.10	2.18	2.14
0.60	2.55	2.68	2.63
0.80	3.20	3.35	3.28

When the average densities in REPS were plotted against the P-32 concentrations in microquries, a standard curve was produced as shown in Figure 3. This curve was used to determine the uptake of radioactive phosphorus by the *Culex molestus* larvae and adults, using the opacity produced by the interaction of these tagged insects with the film emulsion and which was measured in REPS by means of the densitometer.

Results and discussion

Densitometric measurements of the dental films concerning the 14 P-32 concentrations used as breeding media for the immature stages of *Culex molestus,* revealed the fact that only valuable data could be obtained from the low concentrations ranging from 0.05 to 2.0 microcuries per milliliter. Higher concentrations above this range, gave autoradiographs so opaque that they did not give any readings with the densitometer. When the uptake measurements of radioactive phosphorus, P-32, by the larvae bread in the six concentrations rang-

ing from 0.05 to 2 μc/ml., were plotted against the number of days of exposure of these larvae to the radioactivity, Figure 4 was produced. It is apparent in this figure that the P-32 uptake curves for the six
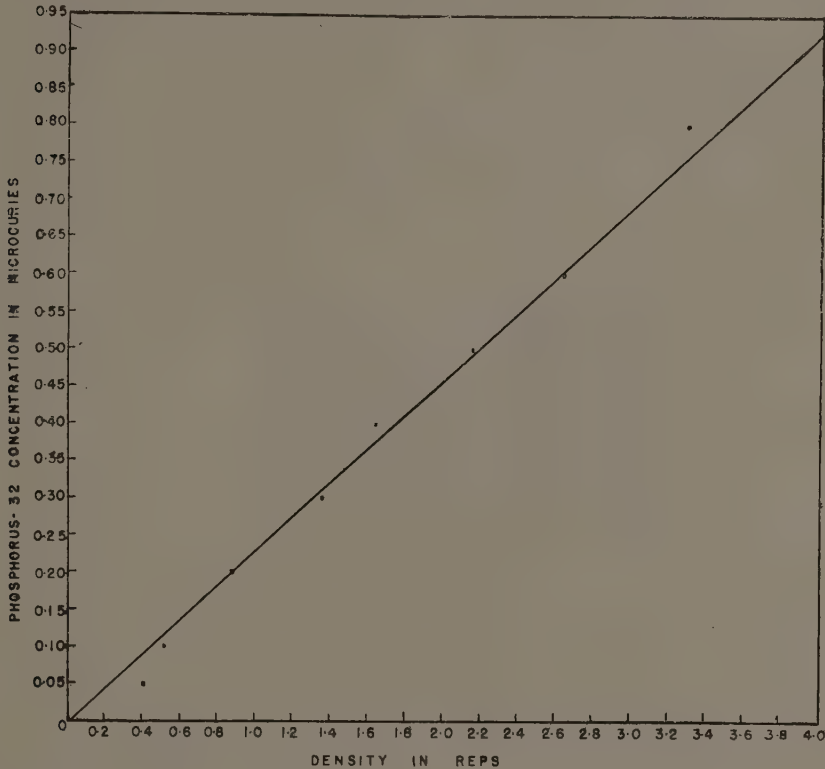
FIG. 3: Standard curve of P-32 as determined by the densitometer.

concentrations go almost parallel and the higher the concentration is, the more the uptake by the larvae. The presence in these curves of definite peaks which coincide for the different concentrations, gives the idea that the mechanism of phosphorus uptake during the different developmental stages of the larvae, is the same whatever the concentration of the radioactive phosphorus used.

It should be added here, that corrections were made for all the uptake measurements in order to bring the radioactive phosphorus-content to its zero time.
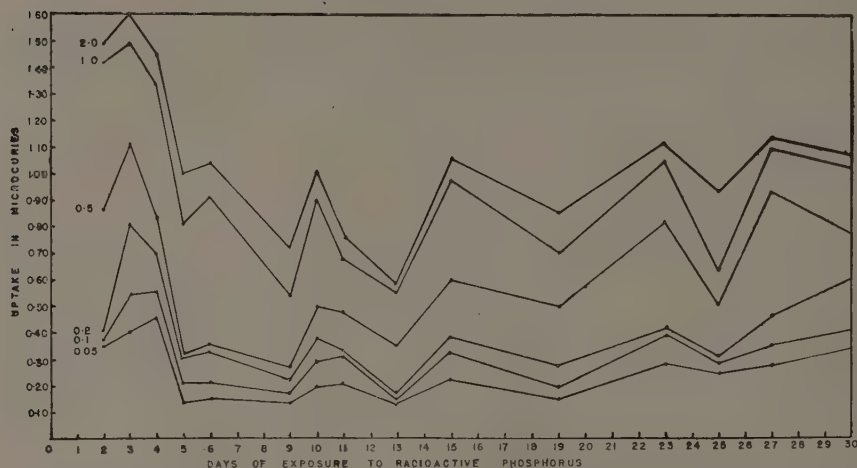
FIG. 4: P-32 uptake by larvae of *Culex molestus* as determined by autoradiography and bred in six media having concentrations of radioactive phosphorus ranging from 0.05 to 2.0 microcuries per .milliliter.

The uptake of P-32 in the different developmental stages of *Culex molestus* is shown in Figure 5. The concentration of the radicactive phosphorus in the breeding medium used here was 0.5 μc/ml. It is apparent from this curve, that *Culex molestus* adults emerging after 42 days from the start of the experiment and bread in as small a dosage
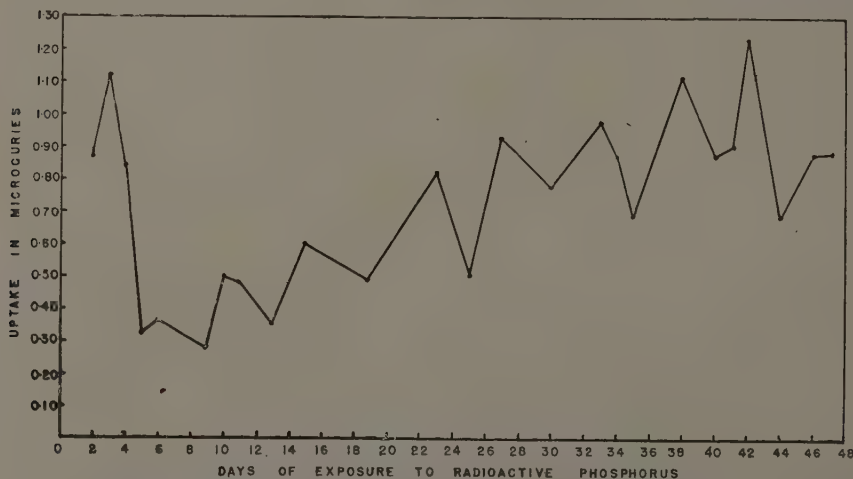
FIG. 5: P-32 uptake of *Culex molestus* larvae and adults, bred in a medium with radiophosphorus concentration of 0.5 microcuries per milliliter.

of radioactive phosphorus as 0.5 µc/ml., still come out with sufficiently high radioactivity amounting to 1.24 microcuries. With this amount of radiation per adult, dispersal experiments using infinitesimal amounts of P-32 in the breeding medium, could be easily carried out.

When the autoradiographs of the adults emerging from breeding media with low concentrations of radiophosphorus ranging from 0.25 to 0.5 µc/ml., were examined, it was clearly obvious that the radioactive phosphorus had concentrated and was localized in definite areas of the mosquito body and particularly in the head region where the brain is situated. Figure 6 shows the autoradiographs of two adult females of *Culex molestus* emerging from a medium with P-32 concentration of 0.5 µc/ml., after 47 days from the start of the experiment.
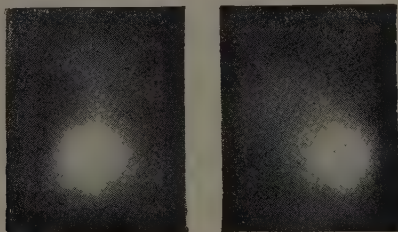
FIG. 6: Autoradiographs of 2 *Culex molestus* adult females.

From the foregoing discussion, it may be concluded that this auto-radiographic technique is an excellent tool for the determination of infinitesimal amounts of radioactivity in very small insects or any other minute organisms. Also it would be possible, using this technique, to study and allocate the distribution of radioactive isotopes inside small and minute creatures.

SUMMARY

(1) A simple apposition method is used for radioactive phosphorus P-32 uptake estimation in the different development stages of *Culex molestus* Forsk.

(2) The method is simply placing the small insects on the non-shielded side of a dental film for one hour. The tin foil present at the other side of the film helps in back-scattering the beta rays emitted from the tagged insects and hence increasing the interaction of the rays with the film emulsion.

(3) Very minute doses of radioactive phosphorus in the form of basic sodium phosphate $Na_2PH^{32}O_4$ ranging from 0.025 to 5.0 microcuries per milliliter per mosquito larva were used.

(4) The P-32 uptake determination was ~~carried out~~ for two months and the results were represented in chromatograms.

(5) Measurements of the opacity produced on the films by the tagged insects, were carried out by means of a densitometer.

(6) Out of the 14 P-32 concentrations used, only valuable data were secured for the low concentrations ranging from 0.05 to 2.0 microcuries per milliliter.

(7) The estimation of P-32 uptake in the insects was determined by the help of a standard curve prepared by using calibrated doses of the radioactive phosphorus, following the same apposition technique used for the insects.

(8) This autoradiographic technique is recommended for uptake estimation of radioactive phosphorus in minute insects especially when infinitesimal doses of the radioactive isotope are used.

ACKNOWLEDGMENT

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STUDIES ON THE PHOSPHORUS-32 UPTAKE IN Schistocerca gregaria (FORSK.) AND Anacridium aegyptium (L.)

[Orthoptera : Acrididae]

(with 2 Text-Figures and 1 Table)

by ALBERT A. ABDEL-MALEK,

Department of Entomology, Faculty of Science, Cairo University,

and MOHAMED F. ABDEL-WAHAB,

Radioisotope Center, Atomic Energy Establishment, U.A.R.

INTRODUCTION

Beta or gamma-emitters are usually used in biological studies to follow events in time or intervals in space. Phosphorus-32, as an example of a beta-emitter, is preferred to a gamma-emitter because its radiation is less penetrating, thus the problem of shielding is reduced. Moreover, P-32 is readily available, relatively cheap, has a convenient half-life and produces no toxic disintegration products. Radioactive phosphorus has been extensively used in biological problems, from the discovery of artificial radioactivity to the present.

In a great number of physiological and ecological insect problems, tagging is required. Suitable methods for marking insects to follow such problems have been greatly needed for a long time. Until recently, tagging was done either by applying brightly-coloured or florescent dyes, metallic dusts or other marking agents. These methods were frequently injurious to the insects and were time consuming. Now insects can be tagged dependably with radioisotopes (JENKINS, 1950, and HASSET and JENKINS, 1949).

RIEGERT et AL (1954) and BALDWIN et AL (1958) successfully tagged grasshoppers with radioactive phosphorus in the study of their dispersion. Also ANDREEV et AL (1958) worked out the rate of penetration and localization of labelled organo-phosphorus and organo-sulphur insecticides in the different organs and tissues of the Asiatic locust (*Locusta migratoria* L.).

In the present paper, two economically-important species of grasshoppers which bring about great direct and indirect damage to crops in the United Arab Republic, namely, *Schistocerca gregaria* (Forsk.) and *Anacridium aegyptium* (L.), have been tagged with radioactive phosphorus. A comparative study of the uptake-distribution of P-32 in seven different organ-tissues in these two species of grasshoppers was undertaken for five consecutive weeks using a reasonable dose of the radioactive phosphorus.

TECHNIQUES

Twenty adults, both males and females, from each of the two species of grasshoppers under investigation, having weights ranging from 1.40 grams to 2.00 grams, were chosen for the experiments. Insects belonging to each species were put in a separate screen breeding cage $60 \times 40 \times 40$ cm. The insects were fasted for 24 hours before they were given the radioactive mash.

Preparation of the radioactive mash

The mash consisted of 1 pound of bran, 50 millilitres of molasses and 2 millicuries of radioactive phosphorus in the form of basic sodium phosphate $N_2HP^{32}O4$, with sufficient water to moisten the mixture. The whole mash was mechanically stirred to give a homogeneous mixture. The grasshoppers were fed on this diet for a period of 48 hours and then on fresh grass for the rest of the experiment.

Radioactive assay

24 hours after feeding on the radioactive mash, one specimen from each species was subjected to the radioactive assay which was developed from that given by KAMEN (1951). The assay proceeded as follows : (a) the insect is anaesthesized by diethyl ether ; (b) the whole insect was weighed and counted by means of a thin end-window G.M. tube, using an automatic Ekco-scaler ; (c) the insect was dissected and

the following seven organs, namely : hind femora, wings, abdominal terga, thoracic muscles, alimentary canal, brain, and genital organs, were dissected out. Each organ was dried by being pressed between two coarse-meshed filter papers, weighed and then digested in about 10 mls. of fuming nitric acid. The digested product was brought up to volume (25 mls.) in a measuring flask, with distilled water. In order to measure the radioactivity of each organ, 2 mls. were taken from the corresponding solution using the G.M. tube and scaler previously mentioned. This technique was repeated one week, 2 weeks, 3 weeks, 4 weeks and 5 weeks from the start of the experiment.

Corrections for decay of the radioactive isotope, efficiency of the G.M. tube and statistical errors were done for every count.

Estimation of phosphorus

In a separate experiment, phosphorus was estimated colorimetrically in the whole insect and in the seven dissected organs using the method of ALLEN (1940). Either the whole insect or the corresponding organ, was healed in 2 mls. of perchloric acid for 6 hours at a temperature of 400 °C., until complete digestion. The digested material was then made up to volume (10 mls.) in a measuring flask. To one ml. of the aliquot, the following solutions were added successively : 1 ml. ammonium molebdate reagent ; 1 ml. 1/50 freshly prepared stannous chloride solution ; 3 drops 2 N Sulphuric acid.

FIG. 1: Histograms of P-32 uptake in seven different organs of *Anacridium aegyptium* (L.) and *Schistocerca gregaria* (Forsk.): (1) one-day after feeding; (2) one week after feeding; (3) two weeks after feeding. — (White column = *Anacridium aegyptium;* black column = *Schistocerca gregaria*).

· The colour developed was extracted by 1 ml. of Isobutanol. The colour-density was then measured by using a Zeiss spectrophotometer PMQ II type in 0.1 ml. quartz equivetts. The quantity of phosphorus was then calculated from a standard curve.

Results and discussions

A study of the six histograms shown in Figures 1 and 2, representing the uptake of phosphorus-32 in the seven different organs under investigation in the two species of grasshoppers, revealed the fact that most of the P-32 uptake was allocated in the soft tissues, namely, the brain and the genital organs. This phenomenon is well observed in Figure 1 (No. 3) and Figure 2 (Nos. 4, 5 and 6). Such uptake of P-32 in the soft tissues started only two weeks after feeding on the
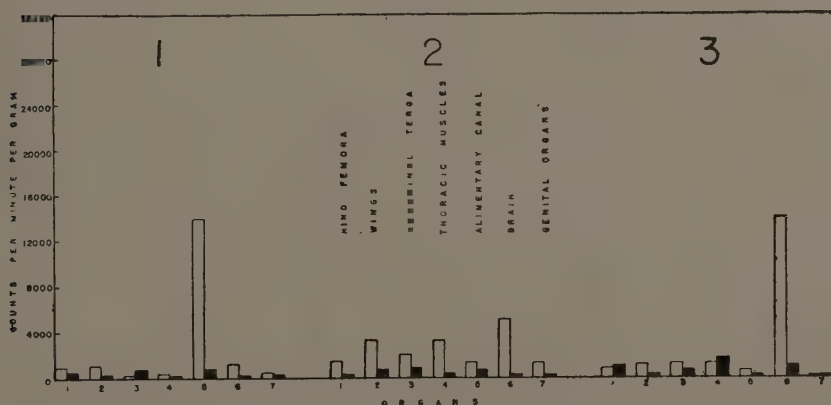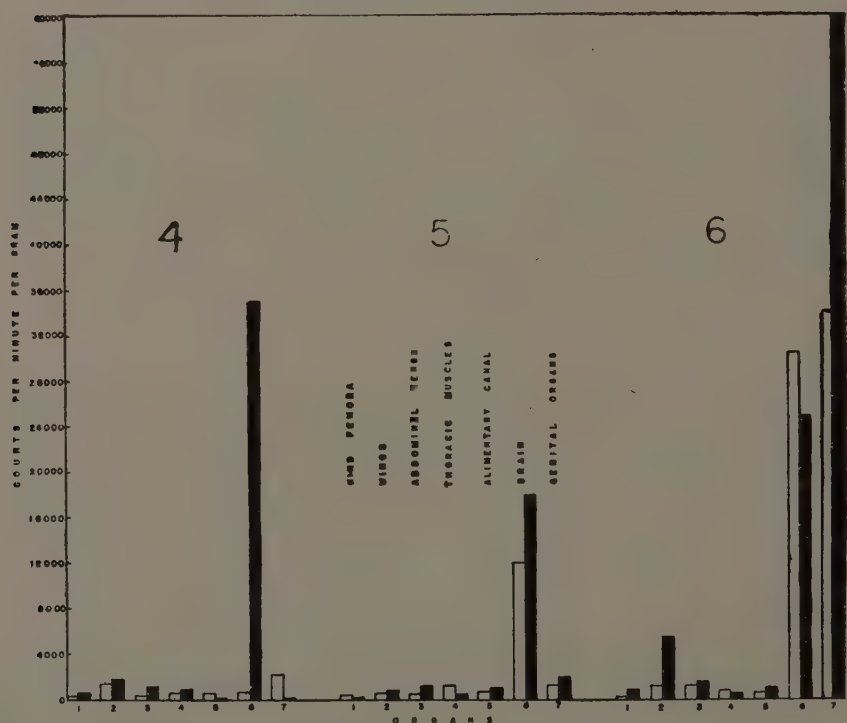

FIG. 2: Histograms of P-32 uptake in seven different organs of *Anacridium aegyptium* (L.) and *Schistocerca gregaria* (Forsk): (4) three weeks after feeding; (5) four weeks after feeding; (6) five weeks after feeding. — (White column = *Anacridium aegyptium;* black column = *Schistocerca gregaria*).

radioactive mash.   The fact that the radioactivity did not appear earlier may be attributed to the time necessary for phosphorus to incorporate in the soft tissues.

Another finding from the histograms is that pronounced radio-activity appeared in the alimentary canal of *Anacridium aegyptium* 24 hours after feeding on the radioactive mash, while in *Schistocerca gregaria* low radioactivity was observed in the same organ, in spite of the fact that both species have consumed more or less equal amounts of the radioactive mash.   In order to confirm that such an observation could not be due to an error in the random selection of the individuals taken for dissection, the radioactivity of the whole insect in both species, was measured.   All the measurements showed that in case of *Schistocerca gregaria,* the counts per minute were found to be slightly higher than that of the background.   Such a surprising phenomenon observed in *Schistocerca gregaria* could be explained by one of two assumptions : (a) that most of the radioactive mash is quickly excreted shortly after feeding, or (b) that the radioactive material is simulta-neously absorbed through the alimentary canal and then distributed to the different organs.   However, the appearance of high radioactivity in the soft tissues and genital organs of *Schistocerca gregaria* one week later than in case of *Anacridium aegyptium* would seem to favour the second assumption.

Colorometric estimation of phosphorus in the dissected organs was found to be in accordance with the radioactivity measurements.   Such an estimation was carried out on *Anacridium aegyptium* by dissecting four specimens of this species, five weeks after being fed with the radioactive mash.

TABLE I.

Colorometric estimation of phosphorus in seven different organs of Anacridium aegyptium *L.*

Organ	Weight of organ in milligrams	Quantity of phosphorus in milligrams per gram of organ
Brain	105.0	40.0
Genital organs	410.8	20.0
Wings	310.0	15.0
Thoracic muscles	616.2	10.0
Hind femora	890.1	5.5
Alimentary canal	869.3	3.2
Abdominal terga	465.3	3.0

It is clear from Table I that the concentration of phosphorus in the soft tissues (brain and genital organs) is the highest, and this agrees with the radioactive measurements. The high amount of phosphorus measured in the brain may be due to the selective uptake of P-32 by the phospholipides which are abundant in nervous tissues. On the other hand, the increase of phosphorus content observed in the genital organs, may be attributed to the fixation of the radioactive phosphorus by the phosphoproteins of which a rich amount is known to occur in these organs.

SUMMARY

(1) Tagging of two species of grasshoppers, namely, *Schistocerca gregaria* (Forsk.) and *Anacridium aegyptium* (L.) was achieved by feeding adults of these species with P-32 enriched bran mixture for 48 hours.

(2) Comparative study of the P-32 uptake in seven different organs, namely : hind femora, wings, alimentary canal, genital organs, thoracic muscles, brain, and abdominal terga, gave a picture of the distribution of the radioactive phosphorus in the two species at regular weekly intervals. The study was continued for five weeks.

(3) Results obtained revealed the fact that out of the seven dissected organs, the selectivity of radioactive phosphorus was highest in the soft tissues as represented by the brain and genital organs.

(4) Colorometric estimation of phosphorus in the previously mentioned organs, was found to be in accordance with the radioactive measurements of P-32.

(5) Distribution of the specific activity of P-32 in the seven different organs during the period of the experiment is represented in six histograms.

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LIFE-HISTORY OF THE PREDATOR MITE, Typhlodromus (Amblyseius) cucumeris OUDEMANS

[Acarina : Phytoseiidae]

(with 3 Tables)

by E.A. EL-BADRY, M.Sc.,
Entomology Department, National Research Centre of Egypt,

and M.A. ZAHER, Ph.D. (Lond.), F.R.E.S.,
Plant Protection Department, Faculty of Agriculture, Cairo University.

INTRODUCTION

Members of the genus *Typhlodromus* and other closely related genera of the subfamily Phytoseiinae have currently received a considerable attention by several authors due to their world wide distribution. Field investigations revealed the importance of these mites as predators on Tetranychidae, Tarsonemidae and Eriophyidae. In 1956, COLLYER reviewed the literature regarding taxonomy, field observation and biology of most members of this family. Since then several species have been reported by CHANT (1956, 1957 A and B, and 1958), MACPHEE and SANFORD (1956), HUFFAKER and KENNETT (1956), DEAN (1957), DOSSE (1957), ANDERSON et al (1958), HUFFAKER (1958) and MOUTIA (1958).

In Egypt, *Typhlodromus* sp. was found by HASSAN et al (1959) on cotton. However, in a survey carried out by the authors in Giza during 1958 and 1959, three *Typhlodromus* species (*cucumeris* Oudemans, *reticulatus* Oudemans and *tiliae* Oudemans), were observed on field and truck crops, ornamentals and fruit trees. *Typhlodromus cucumeris* Oudemans was found to be the most dominant among the three species. Its immature stages and adult were described by CHANT (1957). Therefore, a laboratory study on the life-history, feeding habits and amount of food consumed was undertaken during the summer to evaluate its probable predatory effect in the field.

MATERIAL AND METHODS

Adults of *Typhlodromus cucumeris*, used in the course of this investigation, were obtained from egg-plants grown on the farm of the Faculty of Agriculture at Giza. Rearing techniques followed during this experiment were formerly described by ZAHER and EL BADRY (1960). Eggs of the widely distributed *Tetranychus cinnabarinus*, were used for food, and sweet potato cuttings with one leaf each were used as host plant.

Forty adult females were left on sweet potato leaves to lay eggs for one day. About 80 larvae, newly hatching from these eggs, were the subject of this study. Only 40 females and 12 males completed their life-cycle. Of the mentioned females 25 were copulated while only 15 were left without mating.

Breeding observations and estimation of the egg numbers consumed by the predators were done twice daily during the experiment.

HABITS AND BEHAVIOUR

Typhlodromus cucumeris was found in close association with spider mites on leaves and twigs of a wide variety of hosts. It feeds on eggs and immature stages of many phytophagous species such as *Tetranychus cinnabarinus, Eutetranychus banksi, Oligonychus terminalis, Brevipalpus* spp. Occasionally, it was found attacking the predator mite *Tydeus* sp. or preying on members of its own species.

Members of this species usually vary in their general coloration as they appear in white, yellow and brown colours. Experiments showed that colour gradients were significantly affected by the type of food offered. A diet of *Tetranychus cinnabarinus* eggs produced white or yellow coloration, while larvae, nymphs or adults of the same prey gave a brown colour.

Although this species has a predatory habit, it was noticed to probe the plant tissues. However, larvae which received no eggs of the prey failed to develop beyond the protonymphal stage.

DEVELOPMENT

During its life-cycle both male and female pass through egg, larva, protonymph, deutonymph and adult stages. About 55 individuals were observed through all the developmental stages.

Eggs are ovate, colourless and translucent. They are laid on both surfaces of the leaves. The incubation period lasted for an average of 2 days when the mean temperature was 85 °F.

The newly-hatched larva is transparent. It was often noticed that larvae moult without feeding. The larval stage lasted for a mean period of 0.6 and 0.7 days for females and males, respectively (Table I).

TABLE I

Duration of different stages of Typhlodromus cucumeris.

Sex	Average duration in days				
	Larva	Protonymph	Deutonymph	Longevity	Life span
Female	0.6	1.5	1.4	40	43.5
Male	0.7	1.5	1.4	19	22.6

HERBERT (1956) found the duration of this stage of *Typhlodromus tiliae* was one day at 60 and 70 °F.

The duration of each protonymphal and deutonymphal stages ranged 1-2 days with an average of 1.5 and 1.4 days successively in both sexes. However, the total period required for development from larva to adult ranged from 3 to 4.5 days with an average of about 3.5 for both females and males.

No quiescent stage was observed for this species, except only when cessation of feeding took place before moulting.

Longivity of adult females reached an average of 40 days while it did not exceed an average of 19 days for males.

Moulting

Before moulting, the active stages enter into a so-called "semi-quiescent stage", during which it stops feeding only, but it can still move. During this stage larva or nymph, extends its mouth parts forwardly and stop moving them.

The moulting process begins by with drawing its mouth parts from the old skin. In the meanwhile it twists its body and pushing itself posteriorly. Then the exuvia splits laterally in the hysterosoma in a shape like a horse shoe separating its dorsal shield from the ventral surface. The individual then crawls out backwardly leaving its old skin which appears very thin, transparent and sometimes could not be seen easily. Moulting process lasts for few minutes.

Mating

Mating takes place soon after the final moult. At the circum-

stances of the experiment it durated from 2 to 5 hours. HERBERT (1956) found that the mating process of *Typhlodromus tiliae* Oudms. lasted from 4-6 hours at 70 °F. while it prolonged to 14-38 hours at 60 °F. MOUTIA (1958) stated that copulation lasted for several hours in *T. caudatus* (Berl.).

The male could mate more than one female, while the latter usually accepted one copulation only. However, sometimes it was noticed that the female was copulated twice. It was also found that unmated females did not accept any copulation two or three days after emergence.

Another phenomenon happening is that unmated females could not oviposit any eggs. This was also observed by HERBERT (1956) and RIVARD (1959), during their study on *T. tiliae* and *Tyrophagus castellanii* (Herst), respectively. Therefore, mating is essential for the reproduction and subsequently for the growth of the populations.

In the mating process, the male shows more activity by running about and moving its legs rapidly. It approaches the female from the front so their mouth parts touch each other and both wait for a while. The male then moves in a half-circle round the female, climbs over its back from behind and later it changes its position. In this case, the male's anterior is situated over the female's posterior. After that, it crawls under the female body which lifts its abdomen and spreads its legs to give room for the male. Both male and female ventral surfaces are facing each other. The female then could run and move to any place leaving the male suspended under it. In the meanwhile the mating process takes place so long as the end of both abdomens are touching each other.

Oviposition

Usually, the female deposits its eggs singly on both surfaces of the leaves. Eggs were usually placed on leaf hairs or on webs spun by red spider mites. During the course of this work the average number of eggs deposited per female was 32, with a maximum of 39 eggs (Table II). The rate of oviposition ranged from 1 to 3 eggs per day with a mean of 1.6 eggs. In 1956, COLLYER stated that the greatest number of eggs laid by female *T. tiliae* was 32 with an everage rate of one egg per day while it reached 50 eggs per female *T. caudatus* as recorded by MOUTIA (1958). No differences, however, were found in the number of eggs laid during day and night.

TABLE II

Mean longevity of female and number of eggs deposited.

	Period in days			Number of eggs/female
	Pre-oviposition	Oviposition	Post-oviposition	
Range	2–5	18–23	9–27	25–39
Mean	2.6	19.6	17.5	32

Usually a time elapses between emergence of female and the beginning of oviposition. This pre-oviposition period varied from 2 to 5 days with an average of 2.6 days. The oviposition period averaged 19.6 days as shown in Table II. Observations also showed that females lived for a mean period of 17.5 days after finishing oviposition. MOUTIA (1958) found that this post-oviposition period of *T. caudatus* lasted from 8-10 days.

Careful examination indicated the occurrence of two types of eggs laid by mated females. Some were little larger and gave rise to females, while the smaller ones always produced males.

Longevity

As shown in Table I, females lived longer than males. The longivity of the former, however, averaged 40 days while the mean period of the latter durated for 19 days. Similar result was reported by HERBERT (1956) who stated that adult males of *T. tiliae* lived for a shorter period than females.

Also experiments as well as HERBERT (1956) indicated that both mated and unmated females did not vary in their longevity.

NUTRITIONAL EXPERIMENTS

In a separate experiment, 20 newly-hatched larvae of the predator were confined singly to sweet potato leaves without any supply of eggs of the prey. All individuals succeeded to reach the first nymphal stage in about 0.5 day. During this stage they lived for about 1 to 3 days and then failed to survive.

Other experiment was conducted to investigate the number of prey eggs consumed by the predator mite during its life span. Results showed that the female predator consumed during its life span more number of eggs than that devoured by the male (Table III). The

mites, however, were inactive during their larval stage as some of them did not feed completely while each of the others consumed not more than one egg.

TABLE III

Number of mite eggs consumed by predator during its life-cycle

Sex	Average numbe of eggs consumed by predator during					
	Larval stage	Proto-nymphal stage	Deuto-nymphal stage	Immature stage	Adult stage	Life span
Female	0.5	50.5	68.4	119.4	924.0	1043.4
Male	0.4	31.0	41.6	73.0	353.0	426.0

A marked change in the feeding activity occurred after the mites get through protonymphal stage as they began to feed voraciously (Table III). Each nymph or adult could suck the egg contents in nearly one moment. The average number of eggs consumed by female and male during different stages were, respectively, 119.4 and 73.0 for immature stages and 924 and 353 for adults. MOUTIA (1958) reported that a total of 493 eggs was consumed during the adult stage of *T. caudatus*. When adding the number of eggs preyed by the predator female and male during its life span, it reached 1043.4 and 426.0 eggs, respectively.

Therefore, it was obviously observed that most amount of eggs attacked were during the adult longevity. The mean number of eggs devoured by a female per day was 23, with a maximum of 39. MOUTIA (1958), during his study on *T. caudatus*, reported that the mean number of eggs preyed by one female per day was 10.6 with a maximum of 16.9.

SUMMARY

Typhlodromus cucumeris was found on vegetation associated with infestation of Tetranychids and Tenuipalpids. Its life-history was studied in the laboratory in July and August 1959. Eggs of the spider mite, *Tetranychus cinnabarinus*, were used for feeding. Feeding habits, hatching, moulting, mating, and oviposition were also studied.

Female deposited an average of 32 eggs singly on both surfaces of the leaf during a period ranging from 18 to 23 days. Unmated females could not produce any eggs. Both males and females lasted for about 3.5 days from hatching to adult emergence. Longevity of

females averaged 40 days while it was reduced to 19 days for males. Females usually stayed, after stopping laying eggs, for a mean period of 17.5 days before dying.

During life span, female consumed a greater number of eggs of the prey than the male. The former fed on an average number of 1043.4 eggs while the latter attacked only 426 in average .

ACKNOWLEDGMENT

We wish to express our deep gratitude to Dr. D.A. CHANT, of the Research branch of the Department of Agriculture of Canada, for identifying *Typhlodromus cucumeris* and *reticulatus,* and to Dr. G.O. EVANS, of the British Museum (Natural History), for identifying the *T. tiliae.*

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A STUDY OF THE MORPHOLOGY
AND FEEDING HABITS
OF CERTAIN SPECIES OF CADDIS LARVAE

[*Trichoptera*]

(with 36 Text-Figures)

by HILMY M. HANNA, M.Sc., Ph.D., F.R.E.S.,
Department of Zoology, University of Assiut.

INTRODUCTION

Very little attention has been given to the biology of the immature stages of caddis flies in Britain. One reason for this, has been the difficulty of naming them in the absence of adequate taxonomic studies, a gap which is being filled by HICKIN (1942-1959) in his series of descriptions of larvae of British caddis flies. Other species have been described by MACDONALD (1950), PHILIPSON (1953), MACKERETH (1954, 1956) and HANNA (1956-1960).

In the present work, the larvae of three more species are described and discussed. A study has also been made of the feeding habits of these larvae

MATERIAL AND METHODS

Larvae of *Apatania muliebris* and *Diplectrona felix* were collected from two fast running streams at Brimbscombe (Gloucestershire). Those of *Hydropsyche angustipennis* were obtained from Foudry Brook at Mortimer, near Reading (Berkshire) and were checked against specimens collected from the Blackwater River at Farely Hill in the same area. The larvae of *Apatania muliebris* were found crawling under-

neath as well as on the sides of stones. Those of *Hydropsyche angustipennis* and *Diplectrona felix* were found in their shelters underneath and among stones.

The descriptions are made from the study of a large number of fully grown larvae.

Freshly collected larvae of all sizes were preserved in 70% alcohol and were then dissected to study their feeding habits.

The mid-gut was carefully removed, opened and its contents was washed with water and examined.

Many larvae were reared to the adult stage and identified from MOSELY (1939).

DESCRIPTIONS

Apatania muliebris (McLachlan)

(Limnephilidae)

CASE (Fig. 1). — Up to 10 mm. long and 3.7 mm. in diameter, tapered, slightly curved, made of sand grains and are lined with large sand grains. Its anterior opening is found on the ventral surface, while the posterior one is partially closed by a silky membrane provided with three small holes.

LARVA. — Eruciform, measuring up to 7.2 mm. long and 1.9 mm. wide.

HEAD (Fig. 2). — Hypognathous and nearly triangular in shape. The fronto-clypeus is chestnut brown at its oral end and yellowish aborally. The aboral part of the fronto-clypeus has four lighter areas. The anterior surface of the genae are yellowish brown except for the region between the eyes. This region is chestnut brown. The eyes are situated on the posterior half of the head. The posterior surfaces of the genae are yellowish brown and are devoid of any pattern. The gular sclerite (Fig. 3) is pyriform and it separates the genae completely.

LABRUM (Fig. 4). — Golden yellow, with the ventral surface provided with a small protuberance bearing 3 setae and a group of hairs on each side.

MANDIBLES (Figs. 5 and 6). — Deprived of teeth, each mandible provided with two setae on its outer margin near the base and a brush of fine hairs on its inner surface.

MAXILLA (Fig. 7). — The cardo is rod-shaped and bears a single seta on its outer margin. The stipes has two setae at its distal margin.

The maxillary palp has four segments. The basal segment bears many hairs, whereas the distal segment bears a few sensillae. The lacinia has a few sensillae and hairs.
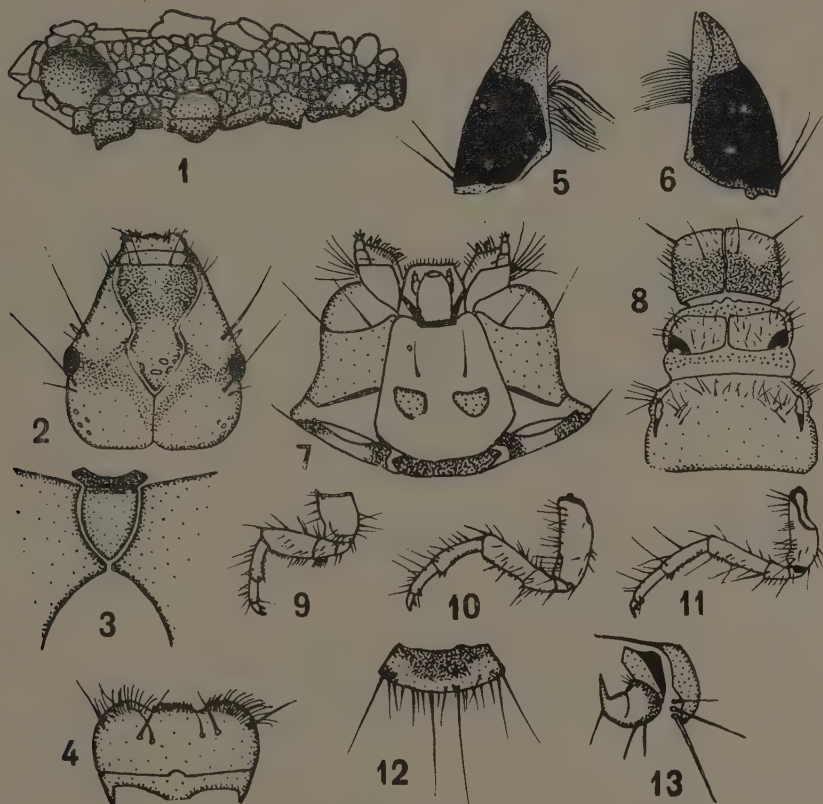
Apatania muliebris (McLachlan)

FIG. 1: Larval case (ventral view). — FIG. 2: Head from the front. — FIG. 3: Gular sclerite from behind. — FIG. 4: Labrum from the front. — FIG. 5: Left mandible. — FIG. 6: Right mandible. — FIG. 7: Labium and maxillae. — FIG. 8: Thoracic nota from above. — FIG. 9: Prothoracic leg. — FIG. 10: Mesothoracic leg. — FIG. 11: Metathoracic leg. — FIG. 12: Anal sclerite from above. FIG. 13: Anal appendage, anal claw and supporting sclerite.

THORAX (Fig. 8). — The pronotum is entirely sclerotised and has a median longitudinal suture. Its anterior third is golden yellow whereas its posterior two-thirds are dark brown. The mesonotum has

two sclerites which are greyish brown except for the postero-lateral corners which are dark brown. There are some reddish brown spots on the anterior and posterior soft margins of the mesonotum. The metanotum is soft except for 2 small lateral sclerites. The anterior margin of the metanotum has a transverse row of setae.

LEGS (Figs. 9, 10 and 11). — The legs are golden yellow and hairy. The inner surfaces of the femora and tibiae bear small spines. Each tibia carries two spurs on its distal end. The mesothoracic and meta-thoracic legs are almost equal in length and are longer than the pro-thoracic legs.

ABDOMEN. — The first abdominal segment has a dorsal, a ventral and two lateral protuberances. The dorsal and ventral ones bear many setae at their bases whereas each of the lateral protuberances bears a few setae. The tracheal gills are formed of single gill filaments and are found on abdominal segments two to seven. The lateral line running from abdominal segments 3 to 7 is formed of fine hairs. The anal sclerite (Fig. 12) is greyish brown anteriorly and golden yellow posteriorly. It bears many setae at its posterior margin. The anal appendage (Fig. 13) has two segments and is supported by a bow-shaped sclerite. The anal claw is simple.

Hydropsyche angustipennis (Curtis)

(Hydropsychidae)

LARVAL SHELTER (Fig. 14). — It is built of small pieces of stones and spins a net of silk at its anterior end and is open at both ends.

LARVAE. — Campodeiform and measuring up to 16 mm. long and 2.5 mm. wide.

HEAD (Figs. 15 and 16). — Prognathous, fronto-clypeus chestnut brown except for 3 yellowish brown areas one of which is situated aborally whereas the two other areas are found in the region between the eyes. Dorsal surfaces of the genae chestnut brown with the exception of two areas around the eyes and two aboral areas which are golden yellow. Ventral surfaces of genae provided with two chestnut brown longitudinal areas. Gular sclerite (Fig. 16) is nearly triangular and chestnut brown and does not separate the genae.

LABRUM (Fig. 17). — Formed of a chestnut brown part which is covered by many hairs and surrounded by a golden yellow part which has a brush of hairs on each side and many setae along its anterior margin.

MANDIBLES (Figs. 18 and 19). — Each mandible has a group of setae on its outer margin. The left mandible bears a hairy brush on its inner surface. The proximal tooth of each mandible is a rounded hump and does not extend as far as the adjacent tooth.
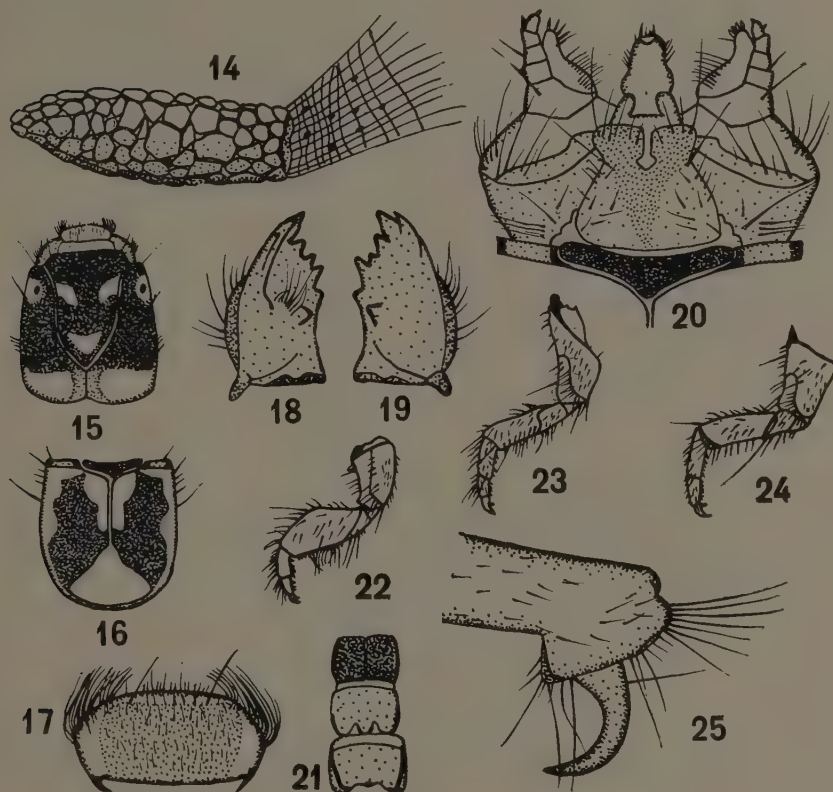
Hydropsyche angustipennis (Curtis)

FIG. 14: Larval shelter. — FIG. 15: Head (dorsal view). — FIG. 16: Head (ventral view). — FIG. 17: Labrum (dorsal view). — FIG. 18: Left mandible. — FIG. 19: Right mandible. — FIG. 20: Labium and maxillae. — FIG. 21: Thoracic nota from above. — FIG. 22: Prothoracic leg. — FIG. 23: Mesothoracic leg. — FIG. 24: Metathoracic leg. — FIG. 25: Anal appendage and anal claw.

MAXILLA (Fig. 20). — The cardo is rod shaped and has no setae. Anterior margin of the stipes bearing many setae. Posteriorly, the stipes has a few setae. The lacinia bears a few hairs and sensillae.

THORAX (Fig. 21). — The pronotum is chestnut brown, entirely sclerotised and has a median longitudinal suture. The posterior and lateral margins of the pronotum are black. The mesonotum is golden yellow and is sclerotised except for its anterior and posterior margins which are soft. Its lateral and latero-posterior corners are black. There is also a small U-shaped black area at its posterior margin. Metanotum sclerotised, except for its anterior and postero-lateral margins which are soft, and provided with a black spot at its posterior margin. There are double tufted gills on the meso- and metasterna.

LEGS (Figs. 22, 23 and 24). — The prothoracic leg is short and robust and has a flattened femur. The inner surfaces of the tibiae and tarsi of all the legs are provided with small spines. The coxae of the prothoracic and metathoracic legs carry plumose hairs.

ABDOMEN. — There are double tufted gills on the ventral surface of the first seven abdominal segments. Four anal gills are also present. The lateral line and anal sclerite are absent. Anal claw (Fig. 25) simple. Anal appendage well developed and bearing a tuft of setae at its distal end.

The larvae of *H. angustipennis* may be easily confused with those of *H. instabilis* described by PHILIPSON (1953). In the former species, however, the double tufted gills are found on the sterna of the first seven abdominal segments whereas they are present on the sterna of the first six abdominal segments in the latter species. BADCOCK (1955) gave a summary of the distinctive characters of use in differentiating the larvae of the 5th instar of *H. fulvipes* from those of *H. angustipennis*.

Diplectrona felix McLachlan

(Hydropsychidae)

LARVAL SHELTER. — The shelter is similar to that of *H. angustipennis*.

LARVAE. — Campodeiform, measuring up to 12 mm. long and 1.9 mm. wide.

HEAD (Figs. 26 and 27). — Prognathous. Fronto-clypeus chestnut brown and covered with fine hairs. Dorsal surfaces of the genae chestnut brown except for two golden areas around the eyes and another yellowish brown area at the posterior margin. Ventral surfaces of the genae yellowish brown except for two oral and two aboral areas which are golden yellow. Gular sclerite (Fig. 27) nearly triangular and chestnut brown.

LABRUM (Fig. 28). — Golden yellow and bearing a hairy brush on each side and a group of small setae along its anterior margin. Both the dorsal and ventral surfaces of the labrum bear fine hairs. There are also two long setae near its anterior margin.
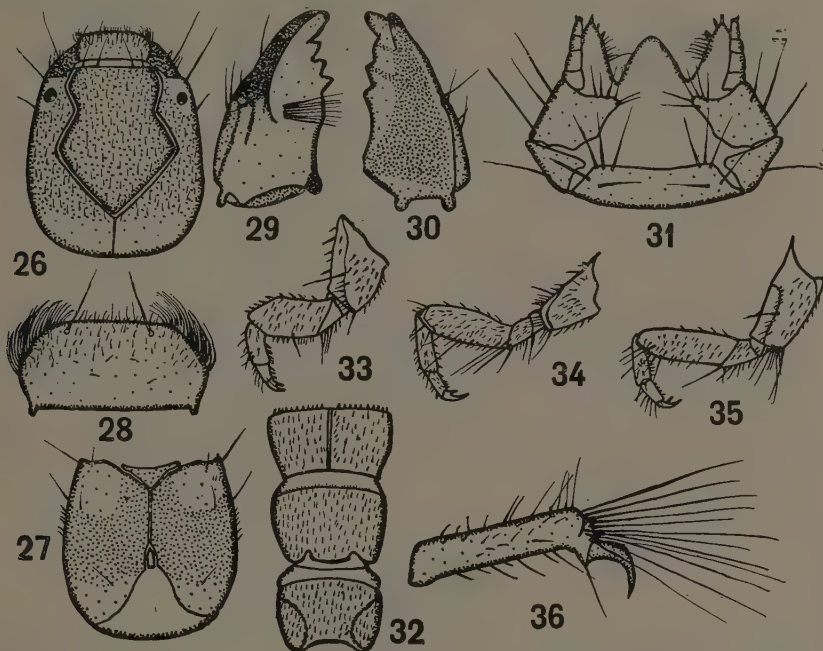
Diplectrona felix McLachlan

FIG. 26: Head (dorsal view). — FIG. 27: Head (ventral view). — FIG. 28: Labrum (dorsal view). — FIG. 29: Left mandible. — FIG. 30: Right mandible. — FIG. 31: Labium and maxillae. — FIG. 32: Thoracic nota from above. — FIG. 33: Prothoracic leg. — FIG. 34: Mesothoracic leg. — FIG. 35: Metathoracic leg. — FIG. 36: Anal appendage and anal claw.

MANDIBLES (Figs. 29 and 30). — Each mandible has four setae along its outer margin. The left mandible has a brush of fine hairs on its inner surface.

MAXILLA (Fig. 31). — The cardo is triangular and has a single seta on its outer margin. The stipes bears three setae on its outer margin and a group of setae on its antero-lateral corner. The maxillary palp has four segments. The lacinia has a few hairs and sensillae along its inner surface.

THORAX (Fig. 32). — The pronotum is yellowish brown, entirely sclerotised and has a longitudinal median suture. The mesonotum is brownish yellow and is sclerotised except for its anterior and posterior regions. The metanotum is golden yellow and has a darker groove on each side. There is a narrow soft area at the anterior end of the meta-notum. All the three thoracic nota are covered with fine hairs. There are double tufted gills on the sterna of the mesothorax and metathorax.

LEGS (Figs. 33, 34 and 35). — The coxae and trochanters of the pro- and mesothoracic legs and the tarsi of the metathoracic legs bear plumose hairs. The tibiae and tarsi of all the legs have small spines on their inner surfaces.

ABDOMEN. — The sterna of the first six abdominal segments bear double tufted gills. In addition, five anal gills are also present. The lateral line and anal sclerite are absent. The anal appendage and anal claw (Fig. 36) are similar to those of *H. angustipennis*.

The larvae of the unique species, i.e. *felix*, belonging to the genus *Diplectrona*, may be easily confused with those of the genus *Hydropsyche*. In *Diplectrona*, however, the fronto-clypeus has no yellow flecks and the larvae possess five anal gills. In *Hydropsyche* the fronto-clypeus has a number of lighter flecks and the abdomen has four anal gills only.

FEEDING HABITS

The gut contents of *Apatania muliebris* proved that its larvae are entirely phytophagous and typical diatom feeders. All the larvae examined contained organic debris and the gut of a few of them re-vealed the presence of fragments of dead leaves.

The larvae of *Hydropsyche angustipennis* fed on amphipod crus-tacea, caddis larvae and cladocera. Filamentous algae and diatoms were also included. RICHARDSON (1921) listed *Hydropsyche* larvae among the planktonic feeders. SLACK (1936) found that the larvae of *Hydropsyche* sp. fed on both animal and plant elements. PHILIPSON (1953) pointed out that the larvae of *H. instabilis* were omnivorous.

The mid-gut of *D. felix* contained May-fly nymphs, caddis larvae, filamentous algae, diatoms, desmids and dead leaves.

The mandibles of *A. muliebris* are stout, have large molar surfaces and possess no teeth and they seem to be adapted for feeding on dia-toms. Those of *H. angustipennis* and *D. felix* have sharp teeth which are well suited for cutting the prey. SLACK (1936) stated that the form

of the mandibles served as a guide for the feeding habit. SILTALA (1907) suggested that the larvae with brushes on both mandibles were phytophagous while those with a brush on the left mandible only were omnivorous. The author's observations on the species examined here confirm SILTALA's suggestion.

WESENBERG-LUND (1913) found a correlation between the position of the eyes and the feeding habits of the larvae. The more carnivorous the animal, the further forward on the head were the eyes placed. SLACK (1936) showed that there were many exceptions to this generalisation.

SUMMARY

(1) The fully grown larvae of *Apatania muliebris* (McLachlan), *Hydropsyche angustipennis* (Curtis) and *Diplectrona felix* McLachlan are described and figured in detail.

(2) The gut contents of *A. muliebris* showed that its larvae are phytophagous and typical diatom feeders.

(3) The larvae of *H. angustipennis* and *D. felix* were found to be omnivorous.

(4) It is suggested that the mandibles, of the three species examined here, are adapted for the feeding habits of the larvae.

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A STUDY ON THE EFFECT OF MALATHION AND KATELSOUS ON STORED GRAIN PESTS

(with 2 Tables)

E.H.N.

by M. ABO ELGHAR and A. BADAWY,

Plant Protection Department, Faculty of Agriculture,
Ain Shams University.

The present world losses of stored grains were recently estimated by the Food and Agriculture Organization to be about twenty-six millions metric tons annually, or at least 5% of the world production of cereal grains. These losses consist of lowered weight and food value, insect adulteration, heating of grains and low germination of seeds.

FARRAR and WRIGHT (1946) concluded that excellent protection may be given stored grains used for seed by using the chlorinated hydrocarbon insecticides. All types of seeds may be protected from insect attack by admixture of 2.5% DDT. According to their observations, such application will not affect seed germination. ZINKERNAGEL et al (1946) stated that wheat grains may be protected by admixture of 100 p.p.m. of DDT. Although this gives only 4-6 p.p.m. in flour (below the 7 p.p.m. tolerance), the fact that flour is such a stable element in the daily diet does not recommend its use. GAY (1947) found that the addition of 0.4 p.p.m. of BHC to the top 6 inches of wheat is more safer and effective, but the taint of this product militates against its use. To avoid having insect poisons in contact with foodstuffs, FITZGERALD (1944) prefers the use of inorganic ammonium salts which are gustatory prepellents and of which, the most suitable is ammonium chloride.

Katelsous, a very fine powder containing sulphur (16%) and rock phosphate (84%, not less than 47% calcium phosphate, tribasic) has been widely used in Egypt against grain pests ; its action is known to be mechanical. DDT was also used on a large scale and proved to be

effective against a fair number of grain pests, but its residues are persistent and tend to accumulate in the body tissues. Nowadays, Malathion has been successfully and extensively used in many countries for the same purpose. Reports of the American Cyanamide Company (1956) stated that Malathion gives protection for a comparatively long time shortly after application. Its residues does not present any problem. The Canadian Government Officials (after Reports of the American Cyanamide Company) have already accepted its use in a concentration of 0.5% dust at the rate of one pound per 10 bushels of grains. PARKINS. (1958) reported that Malathion was the only organophosphorous compound sufficiently non-toxic to mammals to be used against stored grain pests.

Malathion has been recently introduced to Egypt for the control of various pests. However, nothing has been done concerning its use on cereals. The aim of the present work is to offer a comparative study on the effect of both Malathion and Katelsous on different pests of stored grains.

METHODS AND TECHNIQUE

In the present work, Malathion, Katelsous and a mixture of both were applied to wheat grains of the Touson variety. Malathion was added in the concentration of 1% dust at three rates : one pound of malathion per 100, 500 and 1000 pounds of grains. Katelsous was used in the normal rate, i.e. one pound per 100 pounds of grains. The mixture consisted of Malathion 1% (at the rate of 1/1000) and Katelsous (normal rate). Results obtained were compared with a parallel experiment in which grains were left untreated. Grains were either left in uncovered heaps or filled in small gute bags holding about 15 kgs. of grains. The bags were placed in a heavily infested warehouse at El-Marg in a somewhat irregular manner and left for natural infestation. Two replicates were undertaken for each treatment. The experiment started on June 15th and counts were made after 3 months.

A reliable estimate of the population occurring was undertaken by examining three samples of a standard volume (85 cc.) of each replicate. Counts and identification of the species were soon made. Samples of grains were then sifted through a 60 mesh sieve to remove dust, flour and small particles of grains. An estimation of the weight of these samples, the weight of a standard number of grains (1000 grains) taken at random from each sample and the percentage of damaged grains were made.

RESULTS AND DISCUSSION

1.   Nature of infestation

(a) *Number of insects present*

The quantitative investigations of the insect populations of a mass of grain is a difficult problem which has not as yet been adequately attempted. OXLEY and HENDERSON (1944) used a 100 cc. grain sampling spear. HOWE (1952) suggested three methods of the estimation of the number of insects present in stored nuts : i.e. the number per kgm. of nuts in a sample taken with a standard sampling spear, the number found on foot square areas of wall or floor, and the number caught in a water or soap solution traps. He concluded that all these methods were not very successful. However, it was impossible to count the total number of insects in all treatments as it leads to a very large amount of work. Three samples of each treatment (each of a standard volume of 85 cc.) were taken to count and identify the different species of insects present. Although this method is too incomplete to give a true picture of the total number of insects actually present, yet it provides a fairly enough data for comparing the population of the various insects occurring in the different treatments under consideration.

Examination of the experimental bags and heaps of grains reveals the fact that the majority of insects were beetles (Table I). An enormous population of insects were present, mostly of *Calandra oryzae*, *Rhizopertha dominica* and *Latheticus oryzae*. *Calandra oryzae* was the dominant species in all treatments except in heaps of grains of the control experiment and those treated with Katelsous in which *Rhizopertha dominica* and *Latheticus oryzae* were most common.

Other pests present in a comparatively smaller numbers were species of *Tribolium, Palorus* and *Laemophloeus*. *Oryzaephilus surinamensis, Alphitobius diaperinus, Tenebroides mauritanicus* and larvae of the dipterous predator *Scenopinus glabrifrons* were found fairly often singly. Heaps of grains of the control experiment showed considerable webbing due to the presence of the lepidopterous larvae *Pyralis farinalis*. A considerable number of an unidentified hymenopterous parasite was also present in the same lot.

(b) *Control measurements*

Data given in Table I show that in all treatments, heaps of grains were most heavily infested than grains in bags. It seems likely that beetles are unwilling to enter the bags so long as there is sufficient food

TABLE I.

Number of insects and other arthropods associated with stored wheat treated with Malathion, Katelsous and the mixture

(Total numbers in standard volumes of 510 cc.)

Species		Treatments									
		Malathion 1% at the rates of				Katelsous		Mixture		Control	
		1/100	1/500	1/1000							
		Bags	Bags	Bags	Heaps	Bags	Heaps	Bags	Heaps	Bags	Heaps
Rhizopertha dominica	A	0	4	4	6	9	550	59	24	66	224
	D	29	104	24	44	140	112	17	16	20	82
Calandra granaria	A	0	0	1	0	0	0	0	0	0	0
	D	0	7	7	0	5	14	2	0	6	0
Calandra oryzae	A	0	0	15	50	8	6	12	28	16	4
	D	212	528	737	2188	527	60	921	590	138	234
Latheticus oryzae	A	0	0	3	10	35	338	65	90	112	224
	D	38	177	96	240	53	76	96	250	66	202
Tribolium sp.	A	0	0	4	4	2	10	2	6	0	10
	D	20	21	9	212	10	14	17	80	2	56
Alphitobius diaperinus	A	0	0	1	0	2	0	1	2	0	0
	D	2	0	0	0	0	0	0	0	18	0

TABLE I (continued)

Palorus subdepressus	A	0	0	0	0	0	0	0	0	0	0
	D	62	0	0	2	0	6	0	16	0	18
Oryzaephilus surinamensis	A	0	0	0	0	0	0	0	0	0	0
	D	0	2	1	0	0	0	1	0	0	0
Laemophloeus sp.	A	0	0	1	0	1	0	0	2	6	0
	D	41	2	10	10	1	0	13	28	34	26
Tenebroides mauritanicus	A	0	0	0	0	0	0	1	0	4	6
	D	1	1	0	4	0	0	0	0	0	0
Pyraus farinalis	A	0	0	0	0	2	0	0	0	0	18
	D	0	0	0	0	0	0	0	0	0	16
Scenopinus glabrifrons	A	0	1	0	0	0	0	3	0	0	0
	D	0	0	0	0	0	0	1	0	0	0
Pseudoscorpions	A	0	0	1	0	0	0	0	2	6	2
	D	2	1	0	0	0	0	0	0	0	0
Total number	D	407	843	884	2700	466	282	1068	980	284	634
	A	0	5	30	70	59	904	143	154	210	488
% mortality		100	99.4	96.7	97.5	88.8	23.8	88.2	86.4	57.5	56.5

Malathion was used at the concentration of 1% dust at the rates of one pound Malathion per 100, 500 and 1000 pounds of grains. Katelsous was used at the normal rate. The mixture contains Malathion 1% dust (one pound per 1000 pounds of grains) and Katelsous at the normal rate. — A: alive insects. — D: dead insects.

available outside. Considering the percentage of the dead and alive insects suggests that Malathion is much more effective against stored grain insects. The different treatments could be arranged according to the percentage of dead insects present into three groups : those having more than 90% mortality (Malathion-treated grains either in bags or in heaps), those with more than 75% kill (Katelsous-treated grains in bags and Malathion-Katelsous mixture in both heaps and bags), and those of less than 75% kill (heaps treated with Katelsous and the control experiment). It is obvious that Malathion gives almost a full protection to wheat grains either in bags or in heaps (more than 95% kill). When mixed with Katelsous, Malathion increased its effectiveness (mortality percentage being 88.2 and 86.4 in bags and heaps, respectively). Although heaps treated with 1% Malathion dust at the rate of 1/1000 had the highest number of insects, yet most of them were found dead. Katelsous at the rate of 1/100 gave a considerable percentage of kill in bags (88.8% mortality), but gave a poor control (23.8%) when applied to heaps of grains.

2. Loss in weight of grains

In the present study, samples of 1000 grains each, were taken at random from each replicate and weighed. Results are indicated in Table II. A study of this data shows clearly that grains treated with Malathion dust 1% at the rates of 1/100 and 1/500 yielded the highest weights (40.4 and 39.2 gms., respectively). Grains in bags treated with Malathion dust 1% at the rate of 1/1000 and the mixture, gave approximately equal weights (37.6 and 37.9 gms., respectively), while Katelsous alone gave a comparatively lower weight (36.8 gms.). In all treatments, heaps of grains were severely infested with insects and presented the lowest weight ; means of 32.5, 29.8, 25.5 and 22.1 gms. were given to represent the weights of samples treated with Malathion 1/1000, the mixture, Katelsous and the control, respectively.

Considering the percentage loss being zero in the first treatment (Malathion 1/100) and by comparing this with the remaining treatments, it appears that the percentage loss in samples taken from heaps were as a rule much higher than those in bags. The highest percentage loss was however present in samples of the control experiment and those of heaps treated with Katelsous ; the lowest (less than 10%) showed itself in grains of bags treated with all concentrations of Malathion, Katelsous and the mixture. It is also obvious that the percentage loss of weights in grains depends mainly on the number of alive insects present, a positive correlation between these two factors exists.

TABLE II.

Effect of different treatments of insecticides on the weight of grains and percentage of damage

(means of 6 samples)

Treatments	Bags or heaps	% alive insects	Weight of samples (85 cc.)	Weight of 100 grains gm.	% loss weight	% damaged grains
Malathion 1% (1/100)	bags	0	534.2	40.4	0	1.3
Malathion 1% (1/500)	bags	0.6	533.6	39.2	2.9	4.1
Malathion 1% (1/1000)	bags	3.3	466.2	37.6	6.9	24.8
Malathion 1% (1/1000)	heaps	2.5	455.2	32.5	19.6	44.9
Katelsous	bags	11.2	488.7	36.8	8.9	22.5
Katelsous	heaps	76.2	382.2	25.5	36.9	65.1
Mixture (Mal. + Kat.)	bags	11.8	493.8	37.9	6.2	24.3
Mixture (Mal. + Kat.)	heaps	13.6	409.0	29.8	26.2	66.7
Control	bags	42.5	365.0	26.9	33.4	79.8
Control	heaps	43.5	315.0	22.1	45.3	95.1

3.   Percentage of damaged grains

It is a well known fact that insects infestation lowers the germi-
nation of seeds.   In the present study, broken grains, grains with
blemishes and those having a single whole or more, were considered
as damaged grains.   It is assumed that such grains will fail to germin-
ate or at least grow into week plants.

The lowest percentage of damaged grains was observed in grains
treated with Malathion 1% at the rates of 1/100 and 1/500 ; less than
5% of the grains were damaged (Table II).   On the contrary, more
than 95% of the grains of the bags of the control were severely damag-
ed.   Grains in bags treated with Malathion 1/1000, Katelsous, the
mixture gave almost equal percentages of loss, approximately 25% of
these grains were damaged.   However, samples taken from heaps of
the same treatments gave percentage losses of 44.9 and 66.7, respec-
tively.

From the above mentioned results, it can be concluded that a good
protection of grains could be arrived at by the use of Malathion 1%
at the rates of 1/100 or 1/500.

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THE BIOLOGY AND BEHAVIOUR
OF THE COMMON EGYPTIAN
Trogoderma afrum PRIESNER

[*Coleoptera : Dermestidae*]

(with 2 Text-Figures and 6 Tables)

by Dr. AHMAD H. KASCHEF,

*Entomology Department, Faculty of Science, Ain Shams University,
Cairo (Abbassiah).*

INTRODUCTION

HINTON (1945) and others have given a rather full account of the economic importance of the various species of *Trogoderma*. They have pointed out that their respective life-histories are quite similar. However, with each species investigated there are sufficient differences which indicate changes in the physiology. Such differences confirm also the taxonomic treatment of each species.

PRIESNER (1951) could differentiate the common Egyptian *Trogoderma* from the hitherto known species. He pointed out that our species, *Trogoderma afrum*, which is a major pest of cereals in Upper Egypt and the Sudan, comes closest to *Trogoderma granarium* Everts.

The aim of this work was, on one hand, to investigate to what extent the life-history of *T. afrum* has been altered in its duration by variation in temperature, food and humidity and, on the other hand, to establish a foundation of comparative results needed for future nutritional and control studies on this species.

MATERIAL AND METHODS

Specimens of *T. afrum* were supplied by the Entomological Section, Ministry of Agriculture (Cairo). For breeding purposes, the insects were kept in Petri dishes containing "semoule de blé", wheat or millet to a height of about 1 cm. The hatching adults and exuviae were removed weekly. Stock cultures were kept in an electric oven maintained at 32.5 ± 0.5 °C. and $60 \pm 5\%$ R.H. Experiments below 10 °C. were carried out in a refrigerator and those between 12 and 16 °C. were done in a "Chirana" oven equiped with a refrigerating system.

Humidity was regulated by KOH solutions as recommended by BUXTON and MELLANBY (1934) and by SOLOMON (1951).

The types of food used were : "semoule de blé", sesame, polished rice, maize, lentils, millet, broad beans and barley. In some experiments, these grains were brought to a divided condition by grinding with a hand mill. Before use, the food materials were sterilized by putting them in large Petri dishes one inch deep in an oven maintained at 80-90 °C. for six hours. After being sterilized they were placed separately for three or four weeks in desiccators with relative humidities the same as those at which the experiments were to be carried out.

To determine the duration of the life-cycle, "semoule de blé" was chosen as a food since satisfactory results were obtained on this diet.

In order to study the behaviour of the larvae, glass cells made by gumming a glass ring of 15×5, 15×8, 17×6 or 18×10 mm. over a microscopic slide glass were used. The cell had to be covered with another slide glass and the two slides are fastered together with a rubber band.

FECUNDITY

In the study of the biology of *T. afrum* a detailed account of the known facts concerning fecundity would have value.

In order to determine the oviposition of *T. afrum*, thirty pairs of newly hatched insects were kept throughout life at 32.5 °C. and 60% R.H. Each pair of beetles (1 female and 1 male) was placed in a small Petri dish containing about two grams of "semoule de blé". The food was removed and the eggs were counted every day.

Oviposition commenced between one and three days after emergence and continued for 2 to 13 days. The mean number of eggs laid in the first day of the oviposition period was 27.5 or 40.7% of

the total. Then the rate of egg laying decreased rapidly and fairly regular during the rest of the oviposition period as shown in Figure 1. The total number of eggs produced by individual females ranged between 27 and 123 with an average of 8 per female. All the females, without exception, laid more eggs on the first than on any subsequent day, and the greatest number of eggs produced by a single female in one day was 45.
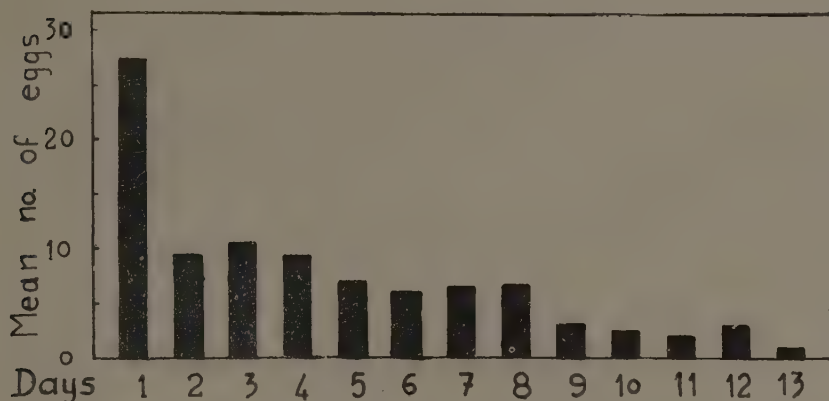
FIG. 1: Mean rate of oviposition in *T. afrum*.

(a)   The effect of temperature on oviposition

The study of temperature as a factor influencing oviposition has two important aspects : (1) the study of maximum and minimum limiting temperatures for oviposition, and (2) the investigation of the effect of different temperatures within these limits on the rate of oviposition and the total egg production.

In *Calandra granaria* L. no eggs are laid at temperatures below 12 °C. (MUELLER, 1927). ANDERSEN (1934) reported that in this species oviposition does not occur at temperatures above 34.5 °C. In *Stegobium paniceum* L. oviposition takes place between 10 and 40 °C. (KASCHEF, 1955).

In order to discover the minimum temperature at which *T. afrum* is able to lay eggs, three series of experiments each consisting of ten pairs of beetles were carried out at constant temperatures of 16.5, 12 and 8 °C. and at 60% R.H. Each pair was kept in a small Petri dish

with two grams of "semoule de blé" which was renewed and the eggs
laid were counted daily. Three females of the first series had, at
16.5 °C., produced a total of 21 eggs or a mean of 7 eggs per female.
In the second and third series of experiments kept at 12 and 8 °C.,
respectively, no eggs were laid. When the relative humidity is 60%,
the minimum temperature for oviposition in *T. afrum* is thus nearly
16.5 °C.

In order to determine the optimum temperature for oviposition
four series of experiments, each consisting of 10 pairs of beetles, were
established. They were maintained also at a constant relative humi-
dity of 60% and at four different temperatures of 36, 32, 28 and 24 °C.
"Semoule de blé" in small Petri dishes was also used as oviposition
medium. The average numbers of eggs laid per female in the four
series of experiments were 64.2, 67.6, 57.5 and 49.1, respectively, and
the mean oviposition rate per female per day in the four series of
experiments were 9.7, 10.7, 5.8 and 4.1, respectively. At a relative
humidity of 60% the optimum temperature for oviposition is nearly
32 °C.

In order to determine the maximum oviposition temperature, an-
other three series of experiments, each consisting of 10 pairs of beetles,
were carried out at 60% R.H. They were maintained at constant tem-
peratures of 47, 44 and 40 °C. The ten females of the first series kept
at 47 °C. died in 4 to 6 days without producing any egg. In the second
series all the beetles died by the end of the tenth day. Three females
only laid a total of 24 eggs. The ten females of the third series of
experiments laid at 40 °C. an average of 28.2 eggs per female. These
experiments clearly demonstrate that, at 60% R.H., the maximum tem-
perature for oviposition is nearly 44 °C.

(b)   The effect of humidity on oviposition

The effect of humidity on oviposition of *T. afrum* has been studied
at four different relative humidities of 30, 50, 70 and 80% and at a
constant temperature of 32.5 °C.

At 32.5 °C. and 80% R.H. it was difficult to keep the food free
from moulds, hence the results obtained at this relative humidity were
excluded. Table I shows that a decrease in relative humidity from
70 to 30% is followed by a decrease in the mean number of eggs laid
per female as well as a decrease in the mean duration of the oviposi-
tion period.

TABLE I.

Effect of relative humidity on oviposition of T. afrum.

Percentage R.H.		Insect number												Mean
		1	2	3	4	5	6	7	8	9	10	11	12	
'70	Total number of eggs laid	83	75	52	86	42	96	127	171	104	90	83	109	93.2
	Oviposition period in days	11	6	7	5	4	9	10	13	9	10	10	11	8.8
50	Total number of eggs laid	16	58	117	92	29	82	51	56	63	80	68	64	64.6
	Oviposition period in days	5	6	6	6	4	4	4	6	5	6	8	5	5.4
30	Total number of eggs laid	16	108	75	83	22	23	46	90	10	87	47	28	44.6
	Oviposition period in days	2	6	5	5	3	4	5	5	4	5	5	5	4.5

LIFE-CYCLE

(a) Effect of humidity on the duration of the developmental stages

The duration of the developmental stages of *T. afrum* is greatly affected by temperature, quality and quantity of food, humidity as well as some other factors. The effect of the relative humidity was dealt with at 30, 40, 50, 60, 70 and 80% R.H. and at a constant temperature of 32.5 °C.

The mean duration of the incubation period, larval stage of non-hibernating larvae, pupation period and total life-cycle, were represented in Figure 2. The results obtained show that at a low relative humidity the mean duration of the development stages is relatively long and it gradually decreases as the relative humidity increases. The males usually have a shorter developmental period than the females and the difference between their life-cycles is quite significant : four and ten days in the average at 70 and 30% R.H., respectively. The results obtained at 80% R.H. were excluded because the food was greatly infested by moulds.

One of the most important biological features of *T. afrum* is the hibernation of the larvae. The latter usually moult 5 or 6 times, but

may moult 5 to 15 times. At 32.5 °C. and 70% R.H., the mean duration of the larval life is 28 days in non-hibernating larvae, and from 244 to 365 days or more[1] in those which hibernate.
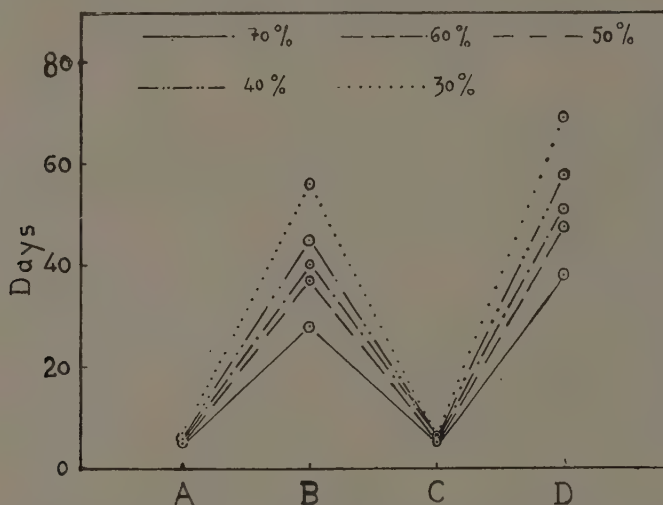
FIG. 2: Effect of relative humidity on the duration of the developmental stages of *T. afrum* (A, incubation period; B, total larval life; C, pupal life; D. total life-cycle).

(b)   The effect of various types of food upon the rate of development of the larvae

The rate of growth of any organisms is greatly affected by food. Growth may be accelerated by certain types of natural food or by vitamins or may be retarded by insufficient food either in quantity or quality. The food constituents vary and the effect of food on the rate of growth in insects depends to great extent on the kind of vitamins present in it.

Much is known now of the basic food requirements of certain insects as well as the effect of mixed diets or diet of single food on them. According to SWEETMAN and PALMER (1928) the duration of the larval life of *Tribolium confusum* Duv. is 17 to 17.2 days on whole rice kernel (hull removed), 21.8 to 27 days on polished rice, 16.6 days on whole

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(1)   There are larvae which have been hibernated a year ago and have not pupated till the publication of this work.

oat kernel (hull removed) and 14.6 days on whole barley kernel. GOOD (1933) pointed out that the entire larval development of the same species was 31 days on middling, 45.7 on oat-meal and 89 days on white flour. The same author found also that the larvae of *Tribolium casta-neum* Hbst. completed their development in 28.9 days on bran, 30.4 on whole-wheat flour, 31.9 on corn meal, 32.6 on middlings, 68.2 on oat-meal and 87.5 days on white flour.

The following series of experiments was to investigate the effect of the following types of food on the duration of the development of the larval instars of *T. afrum* in days : (1) "semoule de blé", (2) se-same, (3) polished rice, (4) maize, (5) lentils, (6) millet, (7) broad beans and (8) barley.

The number of larval instars was determined by rearing the lar-vae singly and freely in small glass cells as described above and count-ing the number of times individual larvae moulted before pupation. After each moult the exuviae could be seen in the cell and were re-moved and recorded. In each kind of food, fifty newly hatching larvae were observed until they reached the pupal stage. A separate record was kept for each larva.

TABLE II.

Duration of larval instars of non-hibernating larvae of T. afrum *fed on ground food materials at 32.5 °C. and 60% R.H.*

Diet	Mean duration of each larval instar in days							Total duration in days	Percentage reached adult stage
	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.		
"Semoule de blé"	6.6	6.2	7	7.8	6.2			33.8	78
	5.8	8	9.7	9.6	7	6		46.1	80.3
Sesame	5.2	5.6	6	8	7.1	7		38.9	82
	5.5	4.6	6	8.1	7.6	9.4	12.1	55.2	77.4
Polished rice	5	6	8.9	13.7	11.6	11	10.9	67.1	46.1
Maize	5	5.7	5.3	7.3	7			30.3	92.3
	5	5.1	4.5	7.5	6.9	6		35	91.7
Lentils	6.3	7.2	13.7	13.5	15.2	16	14	85.9	39
Millet	5	5.6	6.1	7.2	9.4			33.3	91.2
	5	5	5	6.8	10.8	7		39.6	90.5
Broad beans	5.6	7.8	7.1	6.3	8	9.6		44.4	86.4
Barley	5.5	6.1	6.4	7.9	10.3	9.8	10.1	56.1	81.1
	6	7.8	8.2	8.7	9	10.1	9.3	60	81.9

A summary of the date of the mean duration of the larval instars, the total duration of the larval stage and percentage larvae reaching the adult stage was given in Table II. In presence of "semoule de blé", maize or millet there were 5 to 6 larval instars, in sesame or broad beans there were 6 or 7, and in polished rice, lentils or barley there were 7 (or more) larval instars.

The shortest rate of larval development was obtained by feeding on ground maize, millet or "semoule de blé". These single diets are sufficient for *T. afrum*. The relatively poorer development and higher mortality of the larvae occurred by feeding the larvae on ground barley, polished rice or lentils. The latter diet produced the longest rate of development. These results show clearly that the type of food affects greatly the duration of the larval stage and is partly responsible for the variation in the number of larval instars.

SEX-RATIO

Eight cultures of *T. afrum* were established each with 25 pairs (1 female and 1 male) of beetles. The beetles were reared on sesame or ground millet at 32.5 °C. and 60% R.H. The number of hatching adults were counted during 6 or 12 months. The results given in

TABLE III.

Relation between weights of food material and sex-ratio of T. afrum *reared on sesame and millet at 32.5 °C. and 60% R.H.*

Culture number	Weight of food material in grams	Original number of beetles (pairs)	Number of hatching beetles			Percentage		Duration of experiment (months)
			Females	Males	Total	Females	Males	
1	Millet 50	25	81	91	172	8	9	6
2	Sesame 50	25	36	78	114	1	2.2	6
3	Sesame 75	25	152	203	355	3	4	6
4	Sesame 75	25	109	286	395	1	2.6	6
5	Millet 75	25	149	305	454	2	3	12
6	Millet 75	25	226	336	562	2	3	12
7	Sesame 120	25	524	735	1259	5	7	12
8	Millet 120	25	661	778	1339	1	1.2	12

Table III show that more males were produced than females.   The same fact has been recorded in *Lucilia sericata* Meigen (HERMS, 1928), *Trichogramma evanescens* Westwood (SALT, 1936), *Lariophagus distinguendus* Först., *Stegobium paniceum* L. and *Rhizopertha dominica* Fab. (KASCHEF, 1959).   Such effect might be produced either by differential mortality (GOLDSCHMIDT, 1953) or by an alteration of sex due to starvation (HOLDAWAY and SMITH, 1932).

In cultures number 1 and 2, the amount of food (50 gm. per culture) offered to 25 fertilized females (or 1200 growing larvae in the average) was relatively small. In cultures number 7 and 8 the amount of food offered to a similar number of fertilized females was 120 grams per culture.   In both cases an increasing proportion of the progeny were males.   It would, therefore, be possible that this is due to differential mortality rather than starvation.

BEHAVIOUR OF THE LARVAE

In *T. afrum* the sensations which induce the female to oviposit would usually lead to the eggs being laid in environments where sites suitable for larval development are to be found.   In the course of the experiments carried out on oviposition, it was frequently noticed that the eggs were deposited next to previously oviposited eggs.   Millet or wheat grains already containing larvae, also seem to be as acceptable as uninfested grains.   Even if the gravid female did avoid ovipositing on previously infested grains her efforts would be vitiated by the habit of the first instar larvae and the newly hatching second instar larvae of wandering away from the place where they have hatched.   They seem to compete for food and space in order to complete their development.

Superinfestation

It is important to know firstly, whether the *T. afrum* larvae themselves avoid super-infestation[2], and if so, by which sense they perceive the larva in occupation of the grain ; and secondly, if super-infestation is not avoided, how over-crowding affects their development.

Over-crowding may evidently affect living organisms through the limitation of food, oxygen or space or the accumulation of excretory products (conditioning of the medium, ALLEE, 1931, 1934).   When in-

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(2) Super-infestation will design the cases in which a wheat or millet grain is inhabited simultaneously by two or more young of the same species of insects (SMITH, 1929).

·sect larvae are exposed to such conditions this may lead to the death of individuals before reaching maturity, the reduction in size of the pupae and resulting adults, the lowering of the fecondity of the adult females, retardation or stimulation of the rate of development, changes in the sex-ratio of the emerging adult population, or failure to make full use of the food reserves of the medium because of competition for space.

The larvae of *T. afrum* usually bore in a suitable object in the first instar, and usually remain there, feeding upon the interior of the grain till they complete their development.

EXPERIMENT I. — Single larvae were confined in glass cells of the type described above. Each cell contained besides the larva two objects, each composed of different substances, between which the larva had to make a choice of which it was to feed. After 6 hours at 32.5 °C. and 60% R.H. the cells were examined and the positions of the larvae noted. Thirty first instar larvae were offered the choice of each of the following pairs of substances : (1) a piece of millet grain and a piece of cork out to the same shape and size, (2) a false grain made of plaster of Paris mixed with millet flour and a false grain made of plain plaster of Paris. All the larvae choose the millet grains in the first experiment and the plaster of Paris mixed with millet flour in the second experiment.

EXPERIMENT II. — Thirty first instar larvae taken from a culture reared on wheat grains were given the choice of a piece of wheat grain and a piece of cork of the same shape and size. All larvae choose the wheat to the cork. These thirty larvae and another thirty-two first instar larvae taken from a culture reared on millet grains were given the choice of a piece of wheat grain and a piece of millet grain of the same shape and size. Twenty-six larvae (86.7%) of the first group chose the wheat to the millet and twenty-four larvae (75%) of the second group chose the millet to the wheat. The larvae can thus recognize objects containing food and even in the first stage they are able to distinguish between different kinds of food.

EXPERIMENT III. — It has been noticed that not all the first instar larvae can enter intact wheat or millet grains. In each of four small Petri dishes twenty-five first instar larvae were kept with thirty intact wheat grains. Fifty-eight larvae only managed to enter the grains in two days. When intact sesame or millet grains were tested, the mortality was as high as 60 and 72%, respectively. With such a high mortality of the first instar larvae, it was necessary to damage the grains in some standardized way so that the larvae could enter more easily.

Avoidance of superinfestation

Two hundred millet grains were placed into each of three dishes so that they were one layer deep and one hundred fifty first and second instar larvae were introduced into each dish. They were maintained for 24 hours at 32.5 °C and 60% R.H., then the grains were dissected and the positions of the larvae noted. The results given in Table IV show that 42.3% of the first and second instar larvae do not avoid super-infestation. *T. afrum* larvae, however, possess a kind of behaviour by which over-crowding may be avoided, viz. migration.

TABLE IV.

Distribution of first and second instar larvae of T. afrum *among millet grains*

Test	Number of grains containing larvae			
	0	1	2	3
1	77	76	13	7
2	59	96	18	3
3	60	59	27	9

Causes of migration

The non-avoidance of the larvae of *T. afrum* to super-infestation was confirmed by the following experiment. Each of eighty first instar larvae was given the choice between a fresh grain and a grain (marked with a spot of red ink) which contained two living larvae. The two grains were placed side by side in one of the glass cells described above. After 6 hours the grains were examined and the positions of the larvae noted. In 34 cells the fresh grains contained one larva, while in more than the half (46 cells) the infested grains contained three larvae. This result has shown that the larvae entered the two sets of grains and there was no avoidance of the infested grains.

The point to be decided now was whether or not it is the presence of other larvae in the same grain which causes a larva to migrate. A control experiment established by seventy-five first instar larvae placed separately each in a covered glass cell with two millet grains

and the whole were left at 32.5 °C. and 60% R.H. till the larvae have entered the grains. Every two days until adults emerged the grains were examined and the larvae that left the grains in any stage were noted. The larvae usually feed inside the grains until it remains nothing more than small portion of the grain coat or pericarp. The same experiment was repeated with hundred millet grains each containing two first instar larvae. Two or three fresh grains were introduced with each infested grains into a glass cell. The results obtained were given in Table V. By comparing the results of this experiment with those obtained from the control experiment, it is evident that a considerable proportion of the larvae migrated to fresh grains due to the presence of other larvae in the same grain.

TABLE V.

Migration of T. afrum *larvae from infested grains*

Initial number of larvae per grain	Number of grains		Larval instar				
			1st.	2nd.	3rd.	4th.	5th.
			Experiment number I				
1	75	Number of larvae migrated	6	5	4	—	—
		Percentage	7.8	9.1	8.7	—	—
		Number of larvae died	8	6	4	—	—
			Experiment number II				
2	100	Number of larvae migrated	25	27	20	22	—
		Percentage	14.1	19.9	20.6	32.4	—
		Number of larvae died	23	26	12	9	—

Now, if the attack of other larvae to infested grains stimulates migration it may be asked by what sense a larva perceives that there is another larva present ? There are three possibilities : (1) chemoreception, (2) "hearing" or stimulation from mechanical vibrations, and (3) stimulation resulting from actual contact.

(1) CHEMORECEPTION. — If *T. afrum* larvae migrate after detecting the presence of other larvae by chemoreception, freshly killed larvae ought perhaps to cause migration in the same way as living larvae. A

number of infested millet grains each containing one first instar larva
were placed each in a glass cell of the type described above. A freshly
killed larva was introduced into the whole of the grain besides each
living larva. Two fresh grains (marked with red ink) were placed
into each cell. After two days the infested grains were examined and
most of the larvae (45 out of 47) were found in the infested grains;
three larvae died. Chemoreceptive stimuli do not therefore cause
migration.

(2) MECHANICAL VIBRATIONS. — The effect of mechanical vibrations
was investigated as follows. Two grains, each containing two first
instar larvae, were firmly cemented together. Fifty such pairs were
set up. Each of these, together with four fresh grains were placed into
a glass cell. After two days the grains were examined and the posi-
tions of the larvae noted. The same experiment was repeated using
second and third instar larvae. The results obtained were given in
Table VI. If mechanical vibrations were the cause of migration one
might expect a similar increase in migration with an increase in this
factor. Now, one would expect that the amount of vibration or noise
produced by four larvae in two grains cemented together, would be
greater than that produced by two larvae in a single grain. However,
the percentage of first, second and third instar larvae migrating from
the cemented grains were 17.1, 20.3 and 20%, respectively, which are
not significantly different from the percentage of larvae migrating
from single grains when each was containing two larvae (Table V).
Mechanical vibrations do not also seem to cause migration.

<div align="center">TABLE VI.</div>

Migration of T. afrum *larvae and number of larvae died in two days*

Instar	Initial number of larvae per grain	Number of grains	Total number of larvae	Total number of larvae migrating	Percentage of larvae migrating	Number of larvae died in two days
I	2	100	200	30	17.1	24
II	2	80	160	29	20.3	17
	2	100	200	39	22.3	25

(3) CONTACT. — The probable importance of actual contacts between
the larvae as a cause of migration becomes apparent. The reaction of

one larva to the presence of another was investigated under a stereo-microscope. When two larvae in the first, second or third instars were put together in a whole drilled in a wheat or millet grain, they feed together, but as a result of actual contacts with one another, one of them may leave to a fresh grain. They never attack each other. It is seldom to find two individuals of the fourth or fifth instars feeding together in the same hole. This may be due to the fact that the larger size of the latter instars increases the probability of encountering. Moreover, it may be mentioned that the number of larvae migrating from grains which had been cut in half was greater than from whole grains.

From these results it can be concluded that the larvae are adapted, particularly during the early instars, to an independent existence. This will expose them, in choosing and occupying situations in which they complete their development, to competition of other larvae simi-larly engaged. Random encounter within the grains is mainly respon-sible for the migration of the larvae to fresh grains.

SUMMARY

At 32.5 °C. and 60% R.H. the oviposition period of *T. afrum* ranges from 2 to 13 days with an average of 7.1 days. The number of eggs laid per female is 27 to 123 with an average of 77.6. The greatest num-ber of eggs is laid during the first day of the oviposition period, then the oviposition rate decreases rapidly and regularly. The females do not avoid ovipositing on already infested grains. The eggs are depo-sited next to previously oviposited eggs or in between the grains.

At a relative humidity of 60% the minimum, optimum and maxi-mum temperature for oviposition were 16.5, 32 and 44 °C., respectively.

At a constant temperature of 32.5 °C., 70% R.H. is satisfactory for maximum oviposition rate. At 80% R.H. and above, it is difficult to prevent moulds growing on the food. Below 70% R.H. the mean fe-cundity and oviposition period decrease as the relative humidity de-creases.

The mean duration of the incubation period varies from 5 to 7 days at 70 and 30% R.H., respectively. The larvae usually moult 5 or 6 times, but may moult 5 to 15 times. At 32.5 °C. and 70% R.H., the mean duration of the larval life is 28 days in non-hibernating larvae and from 244 to 365 days or more in those which hibernate. The life-cycle is long at low relative humidity and its duration decreases as the relative humidity increases : 69 and 38.2 days in the average at 30 and

70% R.H., respectively. The males usually have a shorter developmental period than the females. The type of food is partly responsible for the variation in the number and the duration of the larval instars. The length of the pupal stage in any of the diets used remains almost the same.

There is no experimental evidence that starvation affects the sex-ratio in *T. afrum*. The higher proportion of males is probably due to differential mortality.

The migration of the larvae to fresh grains may be due to the consumption of the food contents of the infested grains but the influence of the presence of other larvae in the same grain cannot be excluded. The immediate stimulation that leads the larvae to migrate is mainly random encounter inside the grains.

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THE MORPHOLOGY AND HISTOLOGY
OF THE SEXUAL SCENT GLANDS
IN CERTAIN FEMALE LEPIDOPTEROUS MOTHS

(with 8 Text-Figures)

by S. M. HAMMAD, Ph.D.,

Plant Protection Department, Faculty of Agriculture,
University of Alexandria.

INTRODUCTION

Early records state that unfertilized females were placed in gauze-covered cages in open windows in order to attract males of the same species (SEITZ, 1894 ; URBAHN, 1913). The scent producing organs are known to occur in males as well as in females. These organs emit odour to bring the two sexes together from considerable distances for mating (GOETZ, 1951).

In the male moth, the sexual organ consists of tufts of glandular scales or hairs on the legs (ILLIG, 1902), on the wings (ILLIG, 1902 ; FREILING, 1909), or on the abdomen (DICKENS, 1936). In the female moth, the sexual scent glands are always found in the neighbourhood of the sexual openings at the posterior end of the abdomen, mostly between the 8th and 9th abdominal segments. These glands are most developed among female moths in which the eggs are ripe for laying at the time of emergence from the pupa (EIDMANN, 1929). Such moths have usually a short life.

Histologically, the female scent organs (glands) are always more or less identical in structure. They take the form of tufts of modified scales or hairs with gland cells at their bases, or a simple fold in the body-wall consisting of a vacuolated glandular epithelium covered by thin cuticle (WIGGLESWORTH, 1953). Special secretary ducts in these

glandular epithelial cells have not yet been proved for certain, but it is supposed that the secretion leaves through pores in the thin cuticle covering these scent glands (BARTH, 1937).

At present, a research work which seems to have given already promising results is being carried out in the National Research Institute, at Cairo, to isolate and identify the sex attractant odour of the female cotton moth, *Prodenia litura*. The aim of such a work is to produce this attractive substance in the future in large quantities, synthetically and cheaply in the hope of using such substances as a way of biological control of insects.

This has made the author to carry out a comparative study of the morphology and histology of the sexual scent glands in eight female moths, known to be destructive pests in Egypt, i.e. *Laphygma exigua* Hübn., *Agrotis ypsilon* Rott., *Syngrapha circumflexa* L., *Earias insulana* Boisd., *Leucania loreyi* Dup., *Pyrausta nubilalis* Hb., *Chilo simplex* But. and finally the *Platyedra gossypiella* Saunders.

MATERIAL AND TECHNIQUE

The above mentioned moths were obtained in the larval or pupal stage from the Alexandria University Agricultural Experimental Farm. from April until December, 1959. These larvae or pupae were reared easily under laboratory conditions until the emergence of the adult moths. *Agrotis ypsilon* as well as *Syngrapha circumflexa* emerged during May, *Laphygma exigua* emerged during May (in few numbers) and end of August and all of September (in large numbers), while the emergence of *Pyrausta nubilalis* and *Chilo simplex* occurred during September, *Leucania loreyi* emerged during May (in large numbers) and September, and finally *Earias insulana* and *Platyedra gossypiella* emerged during October.

Serial cross, longitudinal and horizontal sections in the whole abdomen of the moths, males and females, were made. As stated before by HAMMAD and JARCZYK (1958), these moths were fixed in hot BOIN's fluid for about 24 hours, dehydrated, and then kept in terpinol for about 1-3 weeks. The specimens were then treated with benzol, 3 changes for about 10-15 minutes each being used. The material was then placed in a mixture of soft paraffin wax (46-48 °C.) and benzol (1 : 1) for about one hour, then removed to 3 changes of hard wax (56-58 °C.). The vacuum pump was used during embedding in the wax. Sections were made at a thickness of 8-10 microns, stained with EHRLICH's or DELAFIELD's haematoxylin and counterstained with eosin. Drawings were made by the author.

DESCRIPTION OF THE SCENT GLANDS

Laphygma exigua Hübn.

(Fig. 1)

The female scent gland is similar in all respect to that of *Prodenia litura* F. In *Laphygma exigua*, the scent gland consists of a characteristic tuft of modified scales covering the whole surface of the 9th abdomenal segment. These modified scales are much thinner than the closing scales which cover the rest of the body.

Each glandular scale is about 2 microns in cross-section. The epidermal cells of the 9th segment are much larger in size than those of the other segments. They are glandular in appearance, stain dark, and the cell boundaries are distinct. Some oil-like droplets of secretion are present in them. Each cell is more or less cubical, being about 8 microns high, and with a rounded nucleus about 4 microns in diameter. The cuticle covering these epithelial glandular cells is thin, being about 8 microns in thickness, and lamellated horizontally. No special secretory ducts in these epithelial cells are observed.

From each glaudular cell, there grows one of these thin modified scales. The plasmatic outgrowth of the cell is seen clearly having the same stain of the cell itself, penetrating the cuticle to the base of the hair which is thinner basally towards the insect cuticle.

Serial sections of the female abdomen show evidentally that there is no sexual scent glands situated between the 8th and 9th abdominal segments.

Agrotis ypsilon Rott.

(Fig. 2)

Sections of the female abdomen show that the epithelial cells lining the intersegmental membrane between the 8th and 9th abdominal segments are obviously very large in size, much larger than those of the other intersegmental membranes. These epithelial cells are invaginated inside the body cavity. They are also well-defined, darkly stained, and glandular in appearance. Each glandular epithelial cell is columnar or cubical, being about 40 microns high, and with a nucleus about 8 microns in diameter. The overlying cuticle is rugose, papillated and bears short spines; it measures about 4 microns high and has no pores nor lamillated stratifications. This scent gland is of the simple and completely closed ring-shaped type which is comparable with that described by URBAHN (1913) in certain Noctuids.

Syngrapha circumflexa L.

(Fig. 3)

The female scent gland is more or less similar to that of *Agrotis ypsilon.* In *Syngrapha,* the inter-segmental area between the 8th and 9th segments has a hypoderm composing of large, well-defined cells. The epithelial cells of the scent gland of *Syngrapha* differ from those of *Agroits* in that its cells are smaller and irregular in shape ; in *Syngrapha,* the cell is about 12 microns in high and with a nucleus about 8 microns in diameter. As in *Agrotis,* the overlying cuticle is also thin, rugose, papillated, and bears short spines ; it measures about 4 microns in high. No lamellated stratifications or pores are visible.

Earias insulana Beisd.

(Fig. 4)

Sections of the female abdomen show obviously that the intersegmental fold between the 8th and 9th abdominal segments travel deep inside the body cavity and has large, darkly-stained and well-defined epithelial cells. These cells are much larger than all the other epithelial cells elsewhere in the integument ; they are more or less columnar or cubical in shape and measuring about 12 microns high and with a rounded nucleus about 8 microns in diameter. The overlying cuticle is as thin as that of *Agrotis* and *Syngrapha ;* it is about 4 microns in thickness. It is rather smooth, with lamellated stratifications and bears many spines. No pores or canals are visible.

The scent gland is of the well-developed, tubular, and closed ring-shaped type. It is comparable with that found by URPAHN (1913) in *Cucullia argentea,* by GOETZ (1951) in *Pygaera pigra* and *Pygaera curtula,* and by DICKENS (1936) in *Ephestia kuhniella, E. cautella, E. elutella* and *Plodia interpunctella.*

Leucania loreyi Dup.

(Fig. 5)

The glandular epithelium of the intersegmental fold between the 8th and 9th abdominal segments of the female moth of this insect is more or less similar in structure and appearance to that of *Earias insulana.* Here, the glandular cells are large, cubical, darkly-stained, and well-defined. Each cell is about 12 microns high and with a
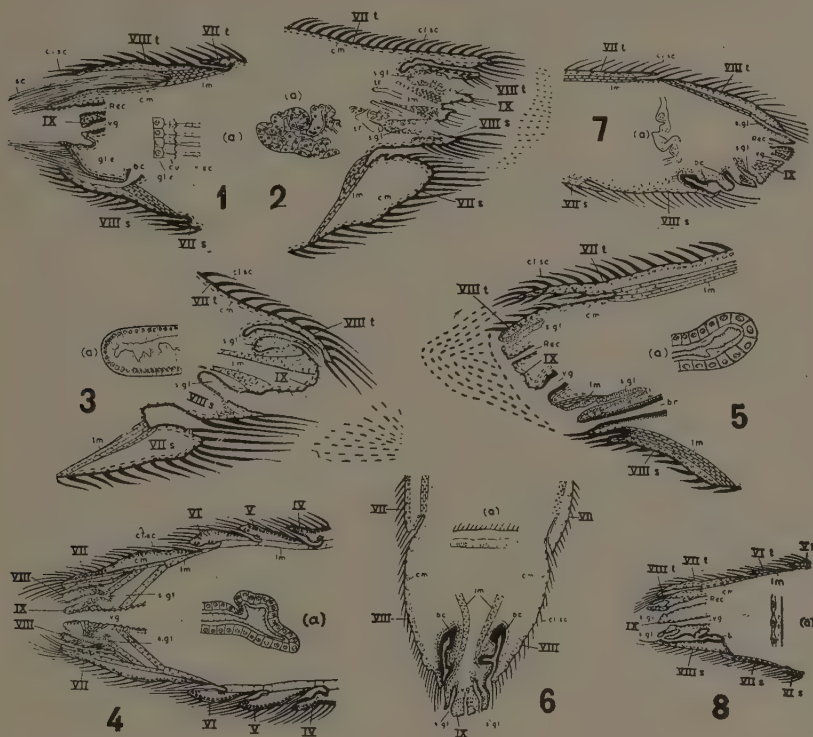
FIG. 1: Simplified longitudinal section of last abdominal segments of the female moth of *Laphygma exigua*, (a) some enlarged cells of the glandular epithelium of the 9th abdominal segment. — FIG. 2: Simplified longitudinal section of the last abdominal segments of the female moth of *Agrotis ypsilon*, (a) enlarged part of the scent gland. — FIG. 3: Simplified longitudinal section of last abdominal segments of the female moth of *Syngrapha circumflexa*, (a) enlarged part of the scent gland. — FIG. 4: Sagital section of last abdominal segments of the female *Earias insulana*, (a) enlarged part of the scent gland. — FIG. 5: Longitudinal section of the last abdominal segments of the female *Leucania loreyi*, (a) enlarged part of the scent gland. — FIG. 6: Simplified sagital section of the last abdominal segments of the female *Pyrausta nubilalis*, (a) some enlarged cells of the scent gland. — FIG. 7: Simplified longitudinal section of last abdominal segments of the female *Chilo simplex*, (a) some enlarged cells of the scent gland. — FIG. 8: Simplified longitudinal section of last abdominal segments of the female *Platyedra gossypiella*, (a) some enlarged cells of the scent gland. — ×12.5 (glandular cells are differently enlarged).

(VIIt, VIIIt, seventh and eighth abdominal tergites; VIIs, VIIIs, seventh and eighth abdominal sternites; IX, ninth abdominal segment; bc, bursa copulatrix; cl.sc, clothing scales; cm, circular muscles; cu, cuticle; lm, longitudinal muscles; gl.e. glandular epithelium; s.gl. scent gland; s.sc, modified scent scales; Rec, rectum; tr, trachea; vg, vagina).

rounded nucleus about 8 microns in diameter. The overlying cuticle is more or less similar in thickness to that of *Earias*, measuring about 4 microns thick. It is also smooth and lamellated horizontally but the spines here are more numerous than those of *Earias*. No pores are visible.

Pyrausta nubilalis Hb.

(Fig. 6)

The epithelial cells, lining the intersegmental fold between the 8th and 9th abdominal segments, are much larger than those elsewhere. They are darkly stained, well-defined, and have a glandular appearance. Each cell is about 20 microns in high and with a nucleus about 8 microns in diameter. Towards the opening of the bursa copulatrix, the glandular epithelial cells become extraordinarily large, being about 35 microns high. Here, it may be interesting to state that there are two bursae copulatrix in *Pyrausta nubilalis,* meanwhile there is only one in each of the previously-mentioned *Agrotid* species. In *Pyrausta,* the overlying cuticle, being about 4 microns thick, is smooth, lamellated horizontally, and bears numerous and fairly long spines which are relatively longer than those of all the species described previously. No pores or canals are visible.

Chilo simplex But.

(Fig. 7)

As in *P. nubilalis,* the epithelial cells or the inter-segmental fold between the 8th and 9th segments are much larger than those elsewhere. They are also darkly-stained, well-defined, irregular in shape and glandular in appearance. Each cell is about 8 microns high and with a nucleus about 4 microns in diameter. Similarly to those of *P. nubilalis,* the glandular epithelial cells of *C. simplex* become larger ventrally towards the opening of the bursa copulatrix, where they become about 20 microns high and with nuclei about 8 microns in diameter. As a matter of fact, there are also two bursae copulatrix in *C. simplex.* In this latter insect, the overlying cuticle of the glandular epithelium is smooth but relatively much thinner than that of *P. nubilalis ;* here, it is about 2 microns in thickness. No lamellated stratifications and no pores or spines are seen.

Platyedra gossypiella Saunders

(Fig. 8)

The epithelial cells of the inter-segment membrane between the 8th and 9th abdominal segments are much larger in size than those of the other segments. They also show a glandular appearance ; they are well-defined and darkly-stained. They are also more or less similar in appearance to those of *Pyrausta* and *Chilo*. In *Platyedra*, the cell is large lengthwise and measures about 4 microns high and with a nucleus about 4 microns in diameter. Similar to that of *C. simplex*, the overlying cuticle is thin, measuring about 2-3 microns thick, smooth, and bears numerous very short spines. Neither lamellated stratifications nor pores are obvious in this overlying cuticle.

DISCUSSION

The fact that moths and butterflies emit an odour for the attraction of the opposite sex has now been known for many years. The adour emitted by the female is to entice the male, while that emitted by the male is used only as a stimulus in copulation (SIEBOLD, 1837 ; RICHARDS, 1927). A male of a certain Lepidopterous insect can be attracted only by the scent from a female of its own species (DICKENS, 1936), therefore, the scent emitted by a female is specific. Yet, PETERSON (1904) recorded that there were cases where males of a certain species were attracted to females of different species. CLARK (1926) suggested it may be even quite possible that in certain species geographical variation in the strength or type of the odour may be found. CLARK continued stating hat this variation may or may not be correlated with variation in colour or in other characteristics of this species, and that this may be one of the factors concerned in the origin of a new species.

URPAHN (1913) and ELTRINGHAM (1926) considered the scent glands in some instances probably might serve the double function of sexual attraction and a repulsive purpose. It is interesting to note here that even some authors (DIXEY, 1910 ; LONGSTAFF, 1904) consider the scents of many Lepidoptera to resemble those of certain plants. Also, PETERSEN (1904) even correlates the odour of the adult with that of its food-plants in the larval stage. This has made DICKENS (1936) to state that PETERSEN'S statement, if correct, can only apply to strictly monophagous species and not to polyphagous species which feed on a wide variety of foodstuffs.

The histology of the female scent organ is described in detail by many authors. Urbahn (1913) found it is *Phalera bucepha'a* in its simplest form as consisting merely of a simple saddle-shaped in the last inter-segmental membrane between the 8th and 9th abdominal segments. An annular or ring-shaped scent gland forms a completely closed ring of glandular epithelium in the inter-segmental fold between the 8th and 9th abdominal segments (Goetz, 1951). In the more developed scent rings, the glandular epithelium of the abdominal fold is strongly enlarged and is deeply invaginated inside the body cavity, while in the less developed scent rings the glandular epithelium is also strongly developed but not deeply invaginated. The deep ring-shaped scent glands are represented in the Noctuids *Cucullia verbasci, Pygaera pigra, P. curtula* (Goetz, 1951), *Cucullia argentea* (Urbahn, 1913), and in the *Ephestia kühniella, E. cautella, E. elutella* and *Plodia interpunctella* (Dickens, 1936). However, Goetz claims that the deeply invaginated ring glands are most probably found in all Noctuid females. In the present work, the ring-shaped scent glands are found in all the described species except that of *Laphigma exigua*. By local surface enlargement of the epithelial cells of the last inter-segmental fold, the scent sacs "sacculi laterales" are formed. These sacs are either formed singly or in pairs on each side of the body and they are also situated either dorsally or ventrally. In *Prodenia litura,* Hammad and Jarczyk (1958) found that the epithelial cells covering the whole 9th abdominal segment is glandular and forms the scent organ. Also, special modified brush-shaped scent scales, much thinner than those closing scales which cover the rest of the body, envelop this 9th segment and have the function of increasing the evaporating surface of the secretion. In the present work, the female scent gland of *Laphygma exigua* is similar in all respect to that of *Prodenia litura*. Here, it is noteworthy to state that Freiling (1909) described scent brushes in the female of *Gonopteryx rhamni* in the inter-segmental fold between the 7th and 8th abdominal segments, close to the entrance of the bursa copulatrix. Also, Richards and Thompson (1932) found a similar brush in the female of *Ephestia figuliella ;* this brush is a firmly attached fan of modified scales arising on each side of the ostium from a narrow chitinized strip in the membrane between the 7th and 8th abdominal sternites.

The method of diffusion of the scent is a matter of controversy. Some authors stated that scent material is diffused to the atmosphere through the apices of the modified scales. They maintain that these scales were provided with capillary tubes in which this scent sub-

stances was held in the form of bubbles (FREILING, 1909). FREILING and ELTRINGHAM (1915) also described pores situated between the striae of the scent scales in certain Lepidopterous insects. On the contrary, DICKENS (1936) did not find any pores in the scales during his work on some Phycitid moths, although he believed that small openings do occur externally between the longitudinal striations of the scales. In this latter case, the scent substance diffuses through the whole chitinous surface of the scale. ILLIG (1902) assumed that the scent material diffuses from the gland of *Lycorea stergati* through a small passage between the stalk of each scale and its alveolus and that the external ribs of the scale serve as an enlarged catchment area for the secretion. With regard to the dissemination of the scent from pores in the overlying cuticle, covering the glandular epithelial cells of the female scent glands, yet there are no records of the presence of such pores in Lepidoptera (URBAHN, 1913; ELTRINGHAM, 1915). URBAHN concludes that the scent material soaks through the lamellae of the overlying chitinous layer until it reaches the epiderm on the surface, through which it slowly diffuses. ELTRINGHAM and DICKENS agree with URBAHN's theory. Therefore, the thicker the chitinous layer, the more secretion it is capable of holding; hence it is assumed that the degree of development of this layer is proportional to the activity of the gland cells.

Early efforts to study the physical and chemical properties of the sex odour were made by ACREE (1935), HALLER, ACREE, and POTTS (1944), AMIN (1949, 1952), FLASCHENTRAGER and AMIN (1950), FLASCHEN-TRAGER, AMIN, and JARCZYK (1957), AMIN and HECKER (1956), HECKER (1955), and BUTENANDT (1955). AMIN (1957), succeeded in extracting and identifying the sex attractant odour of the female silkworm, *Bombyx mori,* as Dimenthylamine. In the latter moth, this sex-attractant matter has been isolated from the "saeuli lateralis" as p-p'-introphenylazobenzoyl derivative which on hydrolysis gives an attractant solution.

Now, it is hoped that the chemists may succeed to produce this attractive substance synthetically and cheaply as well as in large quantities in the hope of using such substances in the biological control of insects.

SUMMARY

(1) The morphology and histology of the female scent organs in eight species of Lepidoptera are described and figured. These species

are, *Laphygma exigua* Hübn., *Agrotis ypsilon* Rott., *Syngrapha circumflexa* L., *Earias insulana* Boisd., *Leucania loreyi* Dup., *Pyrausta nubilalis* Hb., *Chilo simplex* But., and *Platyedra gossypiella* Saunders.

(2) The brush-like type of scent gland occurs in *Laphygma exigua,* where the 9th abdominal segment of the female is completely covered with glandular epithelial cells which have fine modified scales attached to it.

(3) The simple closed ring-shaped scent glands, where the glandular epithelium of the abdominal fold between the 8th and 9th segments is slightly invaginated inside the body cavity, is found in *Agrotis ypsilon* and *Syngrapha circumflexa.*

(4) The more developed closed ring-shaped scent glands, where the glandular invagination between the 8th and 9th abdominal segments dips deep inside the body cavity and taking a tubular form, are found in *Earias insulana, Leucania loreyi, Pyrausta nubilalis, Chilo simplex* and *Platyedra gossypiella.*

(5) The cuticle overlying the glandular epithelial cells of the scent glands of all the studied species is described in detail. No pores are visible in this cuticle.

(6) Serial sections were also made in the male abdomens of all the eight species. No scent glands, similar to those found in their own females, were found.

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lis (Klg.) (Gizah) ; *Tropidotilla fimbriata* (Klg.) (Gizah) ; *Smicronyrme libyca complecta* nov. (Wadi Hoff, Wadi Digla) ; *Smicromyrme matruhana* n. sp. (Mersa Matruh) ; *Smicromyrme longistigma* n. sp. (Wadi Hoff) ; *Smicromyrme rufipes pyramidarum* (André) (Meadi) ; *Smicromyrme rufipes nigra* (Rossi) (Gabal Asfar, Meadi) ; *Smicromyrme priesneri* n. sp. (Wadi Hoff) ; *Smicromyrme gridellii* n. sp. (Kirdassah, Sakkara, Meadi) ; *Smicromyrme tetragona* n. sp. (Wadi Digla) ; *Smicromyrme eltihnica* n. sp. (Wadi El Tih).

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